DOCUMENT RESUME

ED 158 385	EA 010 794
TITLE	National Program for Solar Heating and Cooling of Buildings. Project Date Summaries. Vol. I: Commercial and Residential Demonstrations.
INSTITUTION	Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
REPORT NO	ERDA-76-127
PUB DATE	Aug 76
NOTE	332p.; For related documents, see EA 010 789-796; Not available in paper copy due to small print of original document; Photos may not reproduce ; Prepared by Systems Consultants, Inc., Washington, D.C.
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 060-000-00012-3; $2.35)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Air Conditioning; Climatic Factors; *Data Collection; *Demonstration Projects; Energy Conservation; Equipment Standards; Federal Aid; Government Role; *Heating; Models; *National Programs; Performance Specifications; Program Descriptions; *Solar Radiation; Thermal Environment

ABSTRACT

Three volumes present brief abstracts of projects funded by the Energy Research and Development Administration (ERDA) and conducted under the National Program for Solar Heating and Cooling of Buildings through July 1976. The overall federal program includes demonstrations of heating and/or combined cooling for residential and commercial buildings using available equipment and later incorporating technological advancements directed at improved efficiency and reduced cost or procurement and operation. Volume I presents brief descriptive overviews of the design and operating characteristics of the solar heating and cooling systems and of the structures themselves. Also included are available pictures of the buildings and sketches of the solar energy system. (Author/MLF)

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ERDA 76-127

NATIONAL PROGRAM FOR SOLAR HEATING AND COOLING OF BUILDINGS

PROJECT DATA SUMMARIES

VOL. I COMMERCIAL AND RESIDENTIAL DEMONSTRATIONS

ED158385

EA 010 794

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
DIVISION OF SOLAR ENERGY
WASHINGTON, D.C. 20545

AUGUST 1976

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FOREWORD

The National Program for Solar Heating and Cooling of Buildings, directed by the Energy Research and Development Administration, responds to the Solar Heating and Cooling Demonstration Act of 1974, P.L. 93-409, September 3, 1974. That act called for programs to develop, demonstrate, and promote the use of solar heating and cooling systems. The role of the Federal government in this program is to stimulate use of solar heating and cooling equipment and to assist industry with technology development and systems demonstrations leading to the widespread use of solar energy at the earliest possible time.

The overall Federal program includes demonstrations of heating and/or combined cooling for residential and commercial buildings using available equipment and later incorporating technological advancements directed at improved efficiency and reduced cost of procurement and operation. The schedule adopted for this program follows the Congressional directive in P.L. 93-409, "(b) ... to provide for the demonstration within a three-year period of the practical use of solar heating technology and to provide for the development and demonstration within a five-year period of the practical use of combined heating and cooling technology."

A comprehensive discussion of the National Program for Solar Heating and Cooling of Buildings, is contained in ERDA Report 23A, dated October, 1975. The report is being updated and will be redesignated ERDA 76-6 and is scheduled to be republished October, 1976.

This document presents brief abstracts of projects funded by ERDA and conducted under the National Program for Solar Heating and Cooling of Buildings thru July 1976. It encompasses the following: Commercial and Residential Demonstrations, Demonstration Support and Research and Development. The subject matter is presented in three volumes:

Volume I — Commercial & Residential Demonstrations

Volume I presents brief descriptive overviews of the design and operating characteristics of the solar heating and cooling systems and of the structures themselves. Also included are available pictures of the buildings and sketches of the solar energy system.

Volume II — Demonstration Support

Volume II reports on associated development supporting the demonstration program and the development of system performance standards and criteria and certification criteria.

Volume III — Research & Development

This volume presents a brief description of all of the research and development projects presently supported in the areas of collectors, thermal energy storage, solar heat pumps, solar cooling systems, and controls.

NOTE: The information contained herein represents current plans, and as such, is subject to change. Errors or omissions should be brought to the attention of the Demonstration Branch, Division of Solar Energy.

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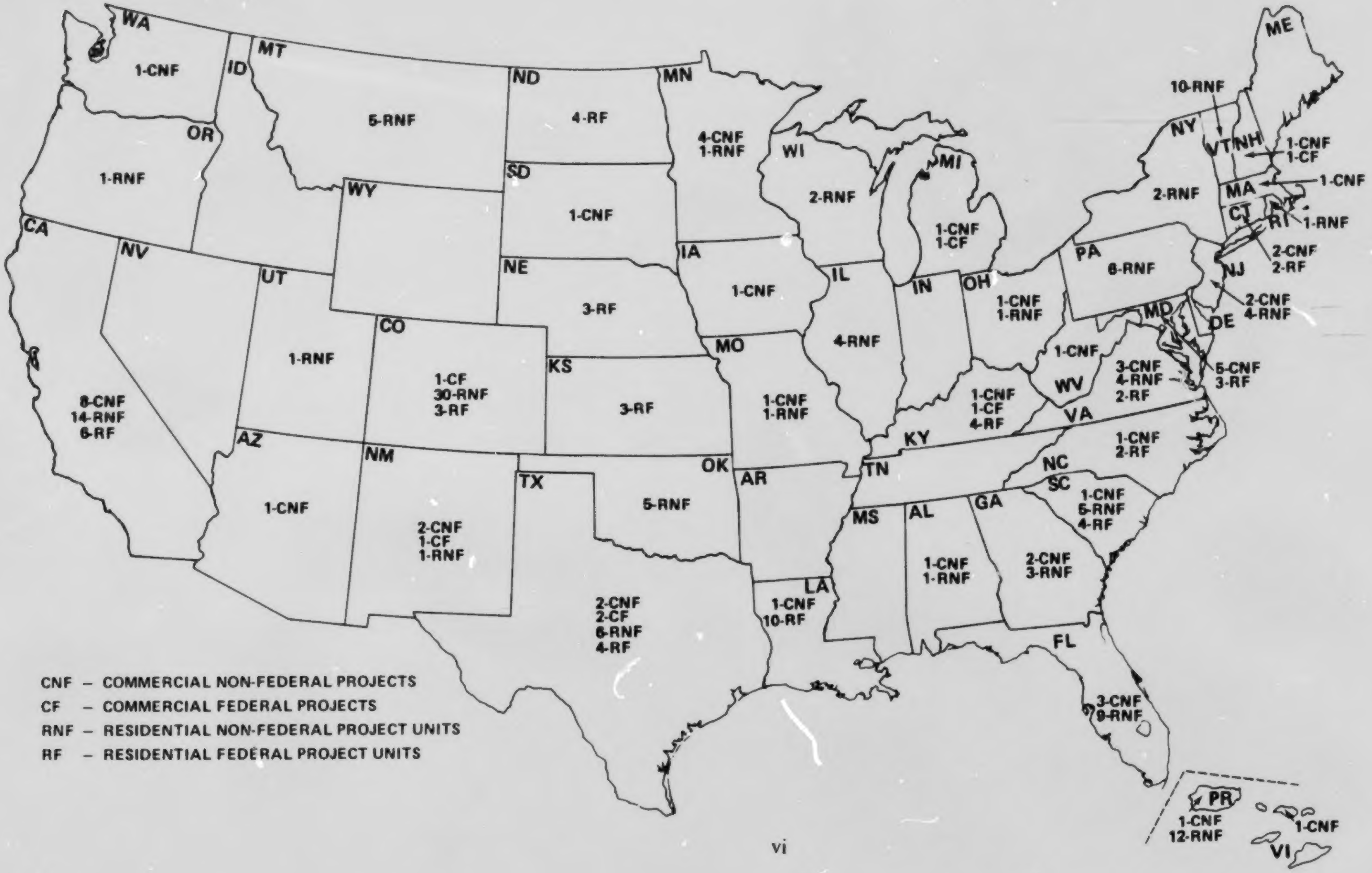
DISTRIBUTION OF SOLAR HEATING & COOLING DEMONSTRATION PROJECTS
COMMERCIAL AND RESIDENTIAL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CNF – COMMERCIAL NON-FEDERAL PROJECTS
CF – COMMERCIAL FEDERAL PROJECTS
RNF – RESIDENTIAL NON-FEDERAL PROJECT UNITS
RF – RESIDENTIAL FEDERAL PROJECT UNITS

INTRODUCTION
VOLUME I COMMERCIAL & RESIDENTIAL DEMONSTRATION PROGRAM

The demonstration program includes commercial and residential type buildings, sponsored by ERDA alone or jointly with other Federal agencies, city and state governments and private agencies.

The commercial demonstration program includes a wide variety of building types, such as: office buildings, schools, fire stations, civic centers, factories, libraries, etc. The residential demonstration program includes both single and multi-family dwellings. It is planned to instrument the majority of projects reflected in Sections I, II and IV in order to gather both operational and installation data to improve the general knowledge of solar energy systems and to provide definitive data for performance and design criteria and economic assessment. A selected number of projects in Section III will be instrumented.

This volume is divided into four sections:

SECTION I	Commercial Demonstration Program — Non Federal Buildings
SECTION II	Commercial Demonstration Program — Federal Buildings
SECTION III	Residential Demonstration Program — Non Federal Buildings
SECTION IV	Residential Demonstration Program — Federal Buildings

The demonstration projects in each section are grouped by states for easy reference. A cross-reference index is provided for Section I, commercial non-federal buildings, to differentiate the origin of each project, e.g., projects in response to the Program Opportunity Notice (PON), proof of concept projects, etc.

SECTION I COMMERCIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

ERDA is reponsible for the management of the Commercial Demonstration Program. These projects are selected primarily from responses to the Program Opportunity Notice (PON). Contained in this section are thirty-two projects selected from responses to the first PON. Also represented are four early proof of concept experiments started in 1974 and other projects started by the National Science Foundation (NSF).

SECTION II COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

ERDA is also responsible for the management of this portion of the program. Projects are selected from proposals submitted by other Federal agencies. Currently participating agencies include DOD, GSA, TVA, and USPS; descriptions of their projects are contained in this section.

SECTION III RESIDENTIAL DEMONSTRATION PROGRAM NON-FEDERAL BUILDINGS

The Department of Housing and Urban Development (HUD) manages this part of the residential program. Projects are selected from responses to Request for Grant Applications (RFGA) issued by HUD. The information reflected in this section represents material from HUD publication, "A Descriptive Summary of HUD Solar Residential Demonstrations", HUD-PDR-162, July 1976.

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

The Department of Defense (DOD) manages this portion of the residential program. Projects are selected by DOD at various military installations throughout the United States.

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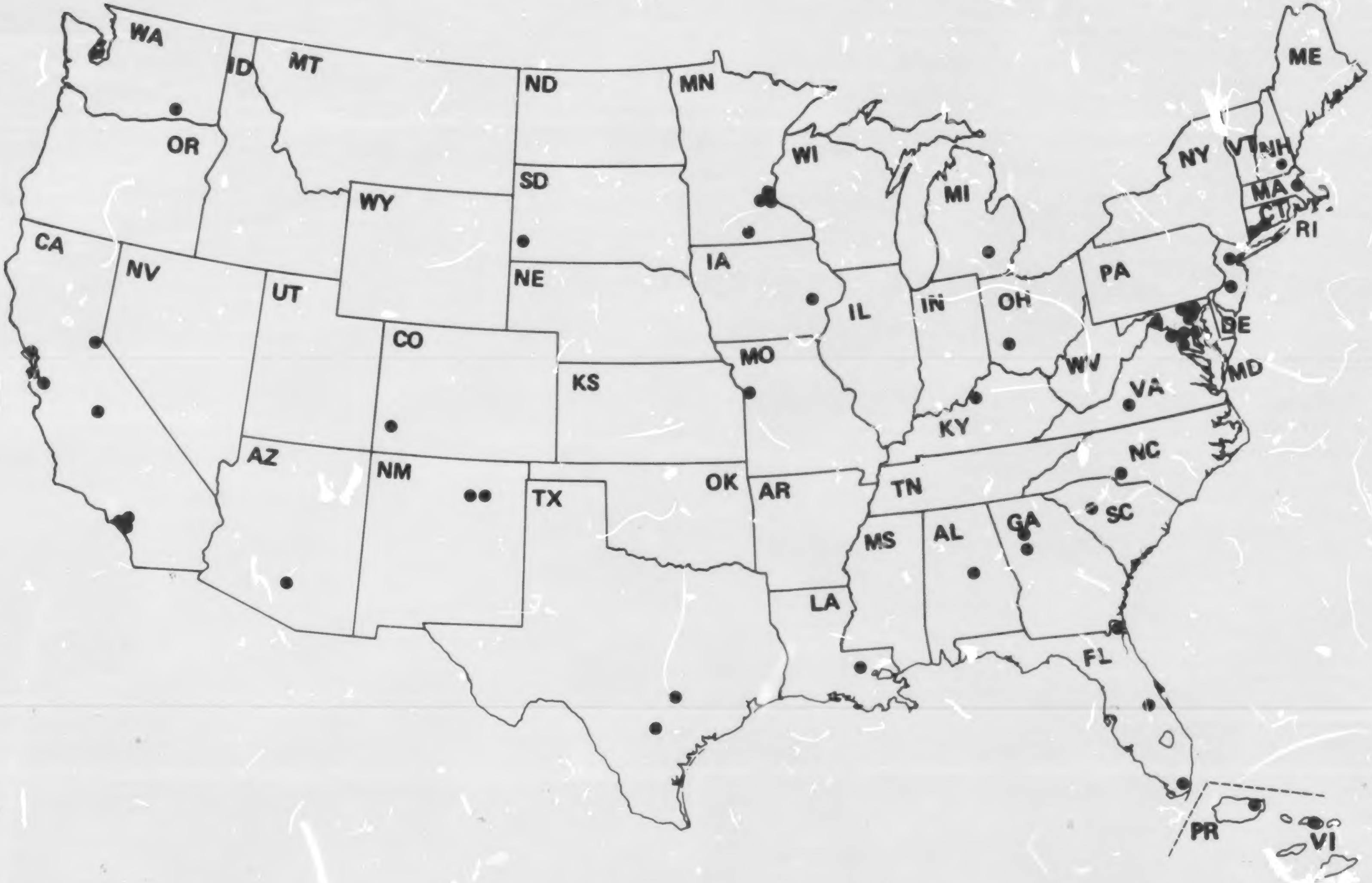
SECTION I

COMMERCIAL DEMONSTRATION PROGRAM NON FEDERAL BUILDINGS

COMMERCIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDINGS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SECTION I COMMERCIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION		
7	ALABAMA	Montevallo	Alabama Power Co.	Office	H	C	HW
8	ARIZONA	Tempe	Tempe Union School Dist. 213	High School	H		HW
9	CALIFORNIA	El Toro	Fredricks Development Corp.	Apartments			HW
10		Fresno	Work Wear Corp.	Industrial Laundry			HW
11		Irvine	Irvine Unified School District	Elementary School	H	C	HW
12		Mill Valley	Iris Images, Inc.	Film Laboratory			HW
13		San Francisco	Storek & Storek	Office	H		HW
14		Santa Clara	City of Santa Clara	Community Center	H	C	HW
15		South Lake Tahoe	Lake Valley Fire District	Fire House	H	C	HW
16		Upland	Fredricks Development Corp.	Apartments			HW
17	CONNECTICUT	Hamden	State of Connecticut	Apartments	H		HW
18		Stamford	Lutz-Sotire Partnership	Office	H		
19	FLORIDA	Coral Gables	Dade County	School	H	C	HW
20		Lake Buena Vista	Reedy Creek Utilities	Office			HW
21		Nassau County	Florida Dept. of General Services	Welcome Station	H	C	
22	GEORGIA	Atlanta	City of Atlanta	School	H	C	HW
23		Shenandoah	Town of Shenandoah	Community Center	H	C	HW
24	IOWA	West Branch	Scattergood School	Recreation Center	H		HW
25	KENTUCKY	Louisville	Rademaker Corp.	Office/warehouse	H		HW
26	LOUISIANA	Baton Rouge	Louisiana State University	Field House	H		HW
27	MARYLAND	Annapolis	Ferguson Corp.	Motel			HW
28		Baltimore	City of Baltimore	Community Center	H		HW
29		Cockeysville	Baltimore County	School	H	C	
30		Silver Spring	Md. Nat'l Cap. Park & Plann. Comm.	Office	H		
31		Timonium	Baltimore County	School	H	C	
32	MASSACHUSETTS	Dorchester(Boston)	City of Boston	School	H		
33	MICHIGAN	Ingham County	Ingham County Board of Comm.	Health Center			HW

SECTION I COMMERCIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDINGS (CONT)

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION		
34	MINNESOTA	Blue Earth	Telex Communications, Inc.	Manufacturing	H	C	HW
35		Minneapolis	University of Minnesota	Bookstore	H	C	HW
36		Brooklyn Center	Osseo School District	School	H		HW
37		St. Paul	Radisson Hotel Corp.	Hotel	H		HW
38	MISSOURI	Kansas City	City of Kansas City	Fire Station	H		
39	NEW HAMPSHIRE	Manchester	Kalwall Corp.	Warehouse	H		
40	NEW JERSEY	Basking Ridge	Somerset County Park Comm.	Auditorium/classroom	H	C	HW
41		Lumberton	RKL Controls, Inc.	Manufacturing	H	C	HW
42	NEW MEXICO	Las Cruces	New Mexico State University	Office/laboratory	H	C	HW
43		Nambe	Nambe Indian Pueblo	Community Center	H	C	HW
44	NORTH CAROLINA	Charlotte	Charlotte Memorial Hosp. & Med. Ctr.	Heatlh Center	H		HW
45	OHIO	Troy	Troy-Miami County Public Library	Library	H		
46	PUERTO RICO	Canovanas	Commonwealth of Puerto Rico	Industrial Factory		C	HW
47	SOUTH CAROLINA	Greenwood	Blakedale Professional Center, Inc.	Office	H		HW
48	SOUTH DAKOTA	Keystone	South Dakota School of Mines	Visitor's Center	H	C	
49	TEXAS	Austin	Radian Corp.	Office/laboratory	H		
50		San Antonio	Trinity University	Energy Plant	H	C	HW
51	VIRGIN ISLANDS	St. Thomas	American Motor Inns, Inc.	Hotel		C	
52	VIRGINIA	Leesburg	Loudoun County School Board	Vocational School			HW
53		Lynchburg	Terrell D. Moseley	Office	H		HW
54		Warrenton	Fauquier County	Classroom	H		
55	WASHINGTON	Richland	Development Dynamics Co.	Office	H	C	HW
56	WEST VIRGINIA	Charles Town	Jefferson County Schools	School	H	C	

NOTE

Since the finalization of this document the following additional projects have been initiated or are in the process of being initiated. Information pertaining to these projects will be included in subsequent revisions.

DISTRICT OF COLUMBIA	Washington	Hogate's/Marriott Corp.	Restaurant			HW
ILLINOIS	Chicago	City of Chicago	"Navy Pier"	H		HW
MISSOURI	St. Louis	Sambo's	Restaurant			HW
PENNSYLVANIA	W. Chester	Bell Telephone	Office/Warehouse			
TEXAS	Dallas	City of Dallas	Recreation & Health Center	H	C	HW

CROSS REFERENCE INDEX

PROOF OF CONCEPT PROJECTS STARTED BY THE NATIONAL SCIENCE FOUNDATION

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE
31	MARYLAND	Timonium	Baltimore County	School
32	MASSACHUSETTS	Dorchester(Boston)	City of Boston	School
36	MINNESOTA	Brooklyn Center	Osseo School District	School
54	VIRGINIA	Warrenton	Town of Warrenton	School

PROJECTS STARTED BY THE NATIONAL SCIENCE FOUNDATION

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE
9	CALIFORNIA	El Toro	Fredricks Development Corp.	Apartments
14		Santa Clara	City of Santa Clara	Community Center
16		Upland	Southern California Gas Co.	Apartments
17	CONNECTICUT	Hamden	State of Connecticut	Apartments
19	FLORIDA	Coral Gables	Dade County School Board	School
22	GEORGIA	Atlanta	City of Atlanta	School
23		Shenandoah	Town of Shenandoah	Community Center
29	MARYLAND	Cockeysville	Baltimore County	School
35	MINNESOTA	Minneapolis	University of Minnesota	Bookstore
40	NEW JERSEY	Basking Ridge	Somerset County Park Comm.	Auditorium/classroom
42	NEW MEXICO	Las Cruces	New Mexico State University	Office/laboratory
43		Nambe	Nambe Indian Pueblo	Community Center
46	PUERTO RICO	Canovanas	Commonwealth of Puerto Rico	Industrial Factory
56	WEST VIRGINIA	Charles Town	Jefferson County Schools	School

CROSS REFERENCE INDEX (CONT)

PROGRAM OPPORTUNITY NOTICE (PON DSE 75–2) PROJECTS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE
7	ALABAMA	Montevallo	Alabama Power Co.	Office
8	ARIZONA	Tempe	Tempe Union School District 213	High School
10	CALIFORNIA	Fresno	Work Wear Corp.	Industrial Laundry
11		Irvine	Irvine Unified School District	Elementary School
12		Mill Valley	Iris Images, Inc.	Film Laboratory
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27	MARYLAND	Annapolis	Ferguson Corp.	Motel
28		Baltimore	City of Baltimore	Community Center
30		Silver Spring	Md. Nat'l Cap. Park & Planning Com	Office
33	MICHIGAN	Ingham County	Ingham County Board of Comm.	Health Center
34	MINNESOTA	Blue Earth	Telex Communications, Inc.	Manufacturing
37		St. Paul	Radisson Hotel Corp.	Hotel
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39	NEW HAMPSHIRE	Manchester	Kalwall Corp.	Warehouse
40	NEW JERSEY	Lumberton	RKL Controls, Inc.	Manufacturing
44	NORTH CAROLINA	Charlotte	Charlotte Memorial Hosp. & Med. Ctr.	Health Center
45	OHIO	Troy	Troy-Miami County Public Library	Library
47	SOUTH CAROLINA	Greenwood	Blakedale Professional Center, Inc.	Office
48	SOUTH DAKOTA	Keystone	South Dakota School of Mines	Visitor's Center
49	TEXAS	Austin	Radian Corp.	Office/laboratory
50		San Antonio	Trinity University	Energy Plant
51	VIRGIN ISLANDS	St. Thomas	American Motor Inns, Inc.	Hotel
52	VIRGINIA	Leesburg	Loudoun County School Board	Vocational School
53		Lynchburg	Terrell D. Moseley	Office
55	WASHINGTON	Richland	Development Dynamics Co.	Office

PROJECT INFORMATION

Owner/Builder: Alabama Power Company

Contractor:

Operational Date: February 1978

Total Estimated ERDA Funds: $333,244

Building
  Type: Commercial Office
  Area: 17,000 sq.ft.

Location: Montevallo, Alabama

Latitude: 33.1°N

Climatic Data

Degree Days	Heating	2665	Cooling	2059
Avg. Temp. (°F)	Winter	54.2	Summer	77.5
Avg. Insol.(Ly/d)	Winter	304	Summer	522

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water ✓

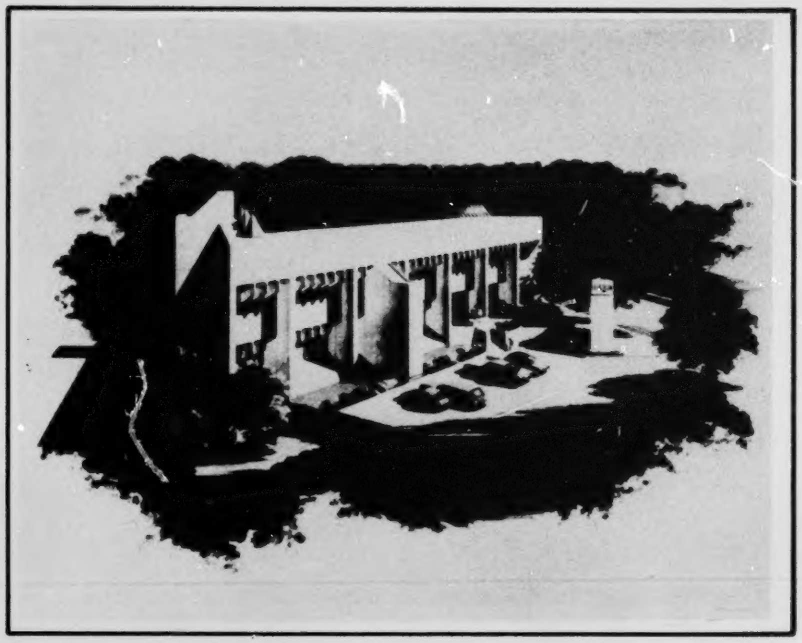
Collector
  Type: Flat-plate/reflector
  Area (sq. ft.): 2,450
  Manufacturer: Pittsburgh Plate Glass, Inc

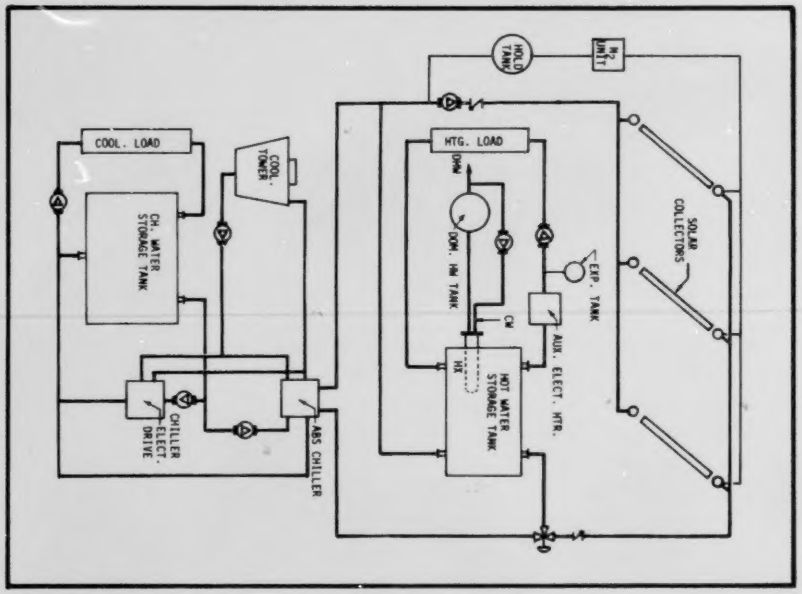
Storage
  Type: Water
  Capacity: 8,000 gallons

Auxiliary System Type: Electric hot water boiler

PROJECT DESCRIPTION

The two-and-one-half story triangular structure is designed to be energy conservative and exceeds the requirements of ASHRAE Standard 90–75. Energy efficiency is achieved through increased insulation in wall and roof areas, utilizing task-oriented lighting design concepts and innovative techniques for shading and reducing the glass areas. South-facing flat-plate double glaze collectors with black chrome selective coating are located on the roof of the building. Separate insulated storage tanks for hot water from the collectors and chilled water produced by the solar powered absorption machine are located in the basement equipment room. The project will provide data and experience for evaluating impacts of solar energy systems and for developing rate structures for the promotion of solar energy systems.

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HX
HOT WATER STORAGE TANK
CHILLER ELECT. DRIVE
ABS CHILLER

PROJECT INFORMATION

Owner/Builder: Tempe Union High School Dist. 213

Contractor: Mardian Construction Company

Operational Date: October 1977

Total Estimated ERDA Funds: $692,100

Building
  Type: High school
  Area: 264,000 sq.ft.

Location: Tempe, Arizona

Latitude: 33.5°N

Climatic Data

Degree Days	Heating	1552	Cooling	3508
Avg. Temp. (°F)	Winter	58.5	Summer	81.7
Avg. Insol.(Ly/d)	Winter	620	Summer	620

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

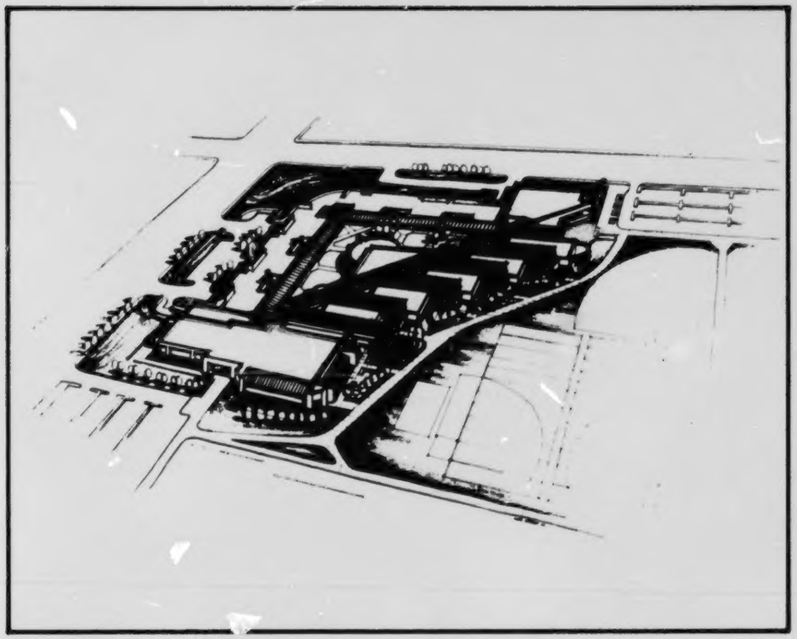
Collector
  Type: Water cooled flat-plate
  Area (sq. ft.): 24,038
  Manufacturer:

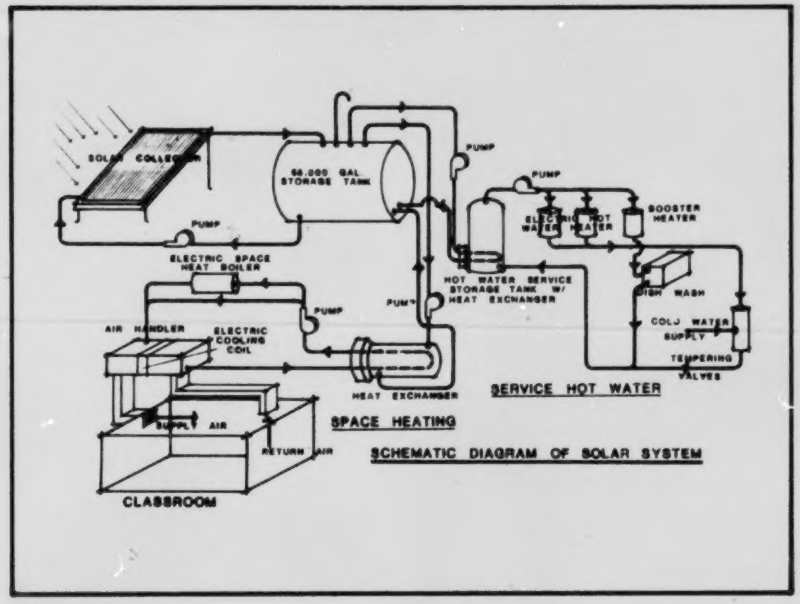
Storage
  Type: Water
  Capacity: 65,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The Corona Del Sol High School has a solar system which will provide thermal energy required for space heating and hot water. Roof top collectors face south at an angle of 32° from horizontal. Additional energy conservation design feature include earth berming at perimeter walls, concentration of building mass vertically and horizontally, site orientation in accordance with sun angles, extensive use of insulation throughout the facility, and natural landscaping surrounding the perimeter and interior court of the facility. Heated water from the buried storage tank will be pumped into heat exchangers transferring the heat energy to a four pipe heating/cooling system and air handlers. Forced air will be discharged from the air handlers as required in various locations of the building.




SOLAR COLLECTOR
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HOT WATER SERVICE STORAGE TANK W/ HEAT EXCHANGER
DISH WASH
COLD WATER SUPPLY
TEMPERING VALVES
AIR HANDLER
ELECTRIC COOLING COIL
HEAT EXCHANGER
SUPPLY AIR
RETURN AIR
CLASSROOM
SPACE HEATING
SERVICE HOT WATER

SCHEMATIC DIAGRAM OF SOLAR SYSTEM

PROJECT INFORMATION

Owner/Builder: Fredricks Development Corp.

Contractor: Southern California Gas Co.

Operational Date: August 1975

Total Estimated ERDA Funds: $391,900 (includes Upland Project)

Building
  Type: Apartments (32 units)
  Area: 57,600 sq.ft.

Location: El Toro, California

Latitude: 33.6°N

Climatic Data

Degree Days	Heating	1355	Cooling	993
Avg. Temp. (°F)	Winter	59.6	Summer	70.1
Avg. Insol.(Ly/d)	Winter	365	Summer	510

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water 70%

Collector
  Type: Copper double glazed flat-plate
  Area (sq. ft.): 908
  Manufacturer: Unitspan

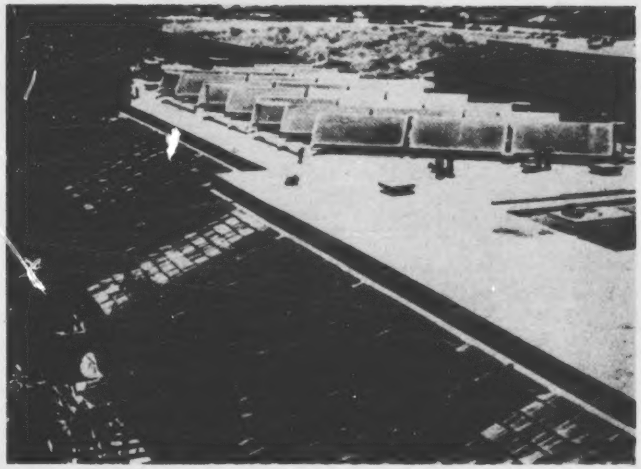
Storage
  Type: Water
  Capacity: 1,200 gallons

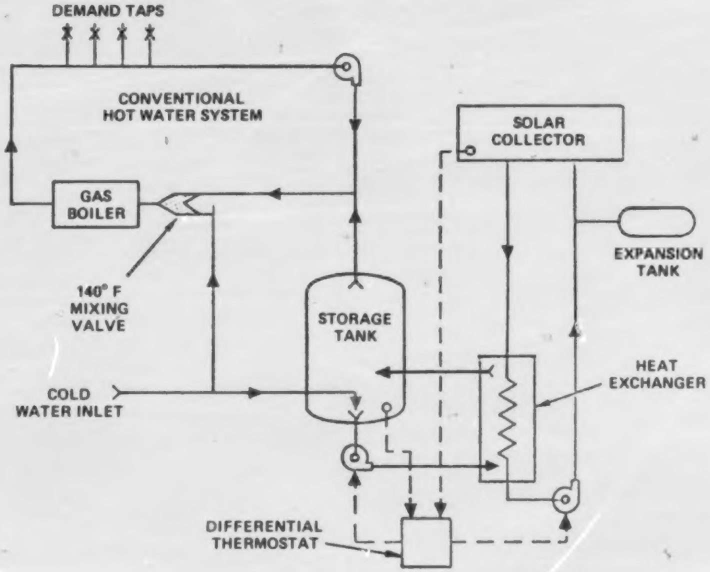
Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

A solar-assisted gas water heater was retrofitted into two El Toro, California apartment buildings. Cost, installation, and performance data will be collected. The data will be used for technical and financial evaluations of the project. The operating costs for systems serving multiple unit buildings are more visible than those for systems serving single family homes. At the same time, multiple unit capital investments are easier to arrange. Cost data from projects such as this will be particularly valuable, helping investors to determine the favorable and unfavorable aspects of investment in multiple unit systems.

This project was funded by the National Science Foundation: ERDA maintains technical cognizance.




DEMAND TAPS
CONVENTIONAL HOT WATER SYSTEM
SOLAR COLLECTOR
GAS BOILER
EXPANSION TANK
140° F MIXING VALVE
STORAGE TANK
HEAT EXCHANGER
COLD WATER INLET
DIFFERENTIAL THERMOSTAT

PROJECT INFORMATION

Owner/Builder: Work Wear Corporation

Contractor: Piper Hydro Inc.

Operational Date: May 1977

Total Estimated ERDA Funds: $105,210

Building
  Type: Industrial laundry
  Area: 32,500 sq.ft.

Location: Fresno, California

Latitude: 36.8°N

Climatic Data

Degree Days	Heating	2650	Cooling	1671
Avg. Temp. (°F)	Winter	51.5	Summer	74.8
Avg. Insol.(Ly/d)	Winter	310	Summer	621

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓

Collector
  Type: Flat-plate
  Area (sq. ft.): 6528
  Manufacturer: Piper Hydro Inc.

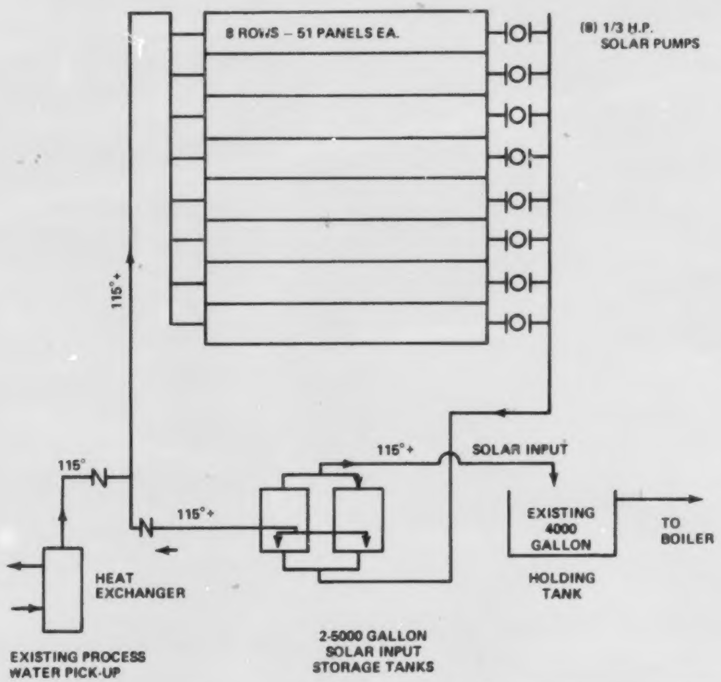
Storage
  Type: Water
  Capacity: 10,000 gallons

Auxiliary System Type: Gas-fired low pressure steam boiler

PROJECT DESCRIPTION

For this project, a solar energy system will supply a part of the hot water requirements of the Red Star Industrial Service Laundry. The laundry is representative, in size and in hot water requirements, of the more than 2000 large commercial laundries in the United States; and it can easily accommodate the proposed solar energy system. The laundry building has a flat roof with an unobstructed south-facing aspect, ideal for the installation of the solar collector. The proposed system for heating the water combines waste water heat recovery by a conventional tube/shell reclaimer with a solar energy preheating system consisting of a solar collector and large hot water storage tank. The laundry's hot water needs are presently supplied by a boiler fired by natural gas. It is estimated that the combined system will produce an energy saving of up to 75 percent.

Picture not available


8 ROWS – 51 PANELS EA.
(8) 1/3 H.P. SOLAR PUMPS
115°+
115°
115°+
115°+
SOLAR INPUT
EXISTING 4000 GALLON
HOLDING TANK
TO BOILER
HEAT EXCHANGER
EXISTING PROCESS WATER PICK-UP
2-5000 GALLON SOLAR INPUT STORAGE TANKS

PROJECT INFORMATION

Owner/Builder: Irvine Unified School District

Contractor:

Operational Date: June 1977

Total Estimated ERDA Funds: $329,870

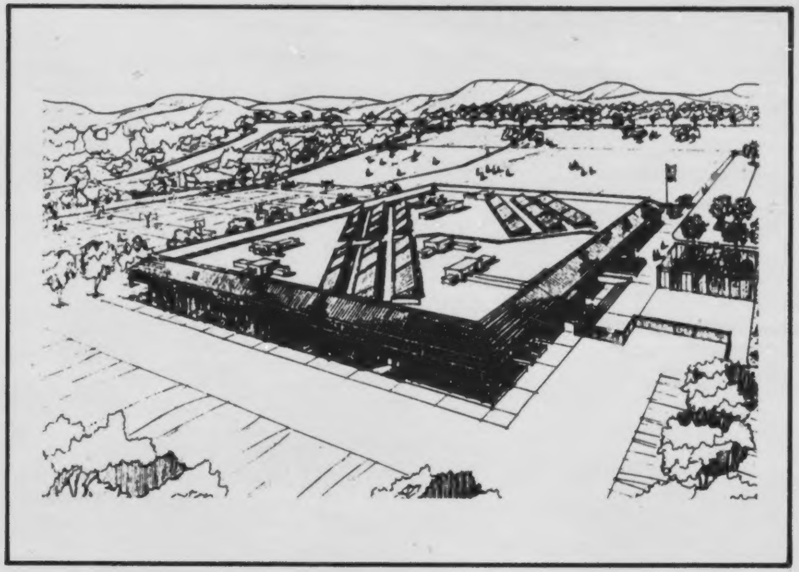
Building
  Type: Elementary school
  Area: 39,500 sq.ft.

Location: Irvine, California

Latitude: 33.6°N

Climatic Data

Degree Days	Heating 1355	Cooling 993
Avg. Temp. (°F)	Winter 59.6	Summer 70.1
Avg. Insol.(Ly/d)	Winter 365	Summer 510



SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water 0%

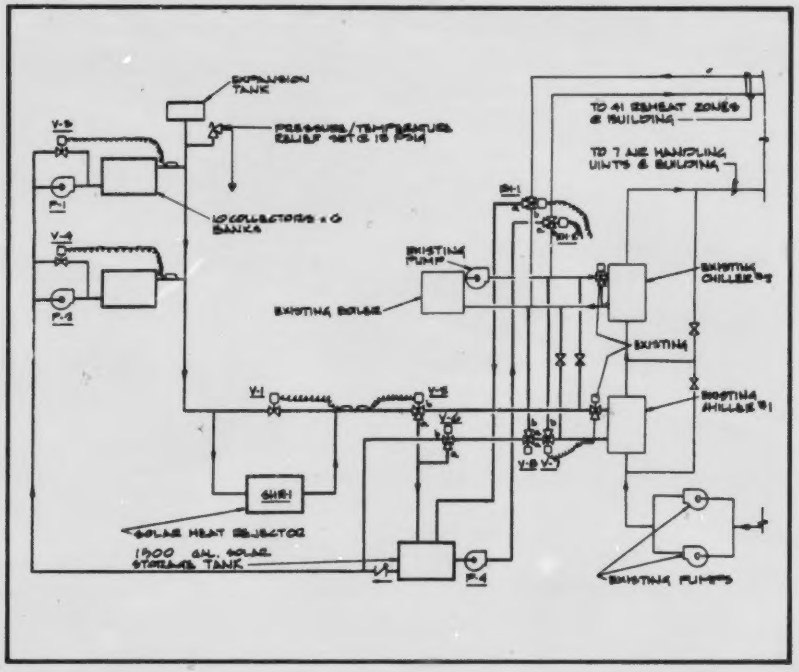
Collector
  Type: Water cooled evacuated tube
  Area (sq. ft.): 5,000
  Manufacturer: Owens-Illinois or Chamberlain Mfg Co

Storage
  Type: Water
  Capacity: 1,500 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project calls for retrofit solar augmentation of the heating and cooling system of the El Camino Real Elementary School. The school is an appropriate subject for the project, because it is new and has good insulation and very few windows. Solar energy will be used to drive one of the school's two ARKLA 100-ton absorption chillers. Irvine is also a good location for the project. It has 70% sunshine during daylight hours, and it is warm enough year round that the collector will not require drainage to prevent freezing. The system's working fluid will be demineralized water with environmentally acceptable corrosion inhibitors as the only additives. The water will be stored in a 1500-gallon above-ground storage tank. Hot water from the boiler is fed directly to fancoil units in the various zones within the building. Cool water from the chillers is provided to cooling coils located in 7 plenums. Fresh air makeup is about 20%.


EXPANSION TANK
PRESSURE/TEMPERATURE RELIEF SET @ 15 PSIG
V-3
P-1
10 COLLECTORS x 6 BANKS
V-4
P-2
TO 41 REHEAT ZONES @ BUILDING
TO 7 AIR HANDLING UNITS @ BUILDING
SH-1
SH-2
EXISTING PUMP
EXISTING BOILER
EXISTING CHILLER #2
EXISTING
EXISTING CHILLER #1
V-1
V-2
V-6
V-8
V-7
SHR1
SOLAR HEAT REJECTOR
1500 GAL. SOLAR STORAGE TANK
P-4
EXISTING PUMPS

PROJECT INFORMATION

Owner/Builder: Iris Images Inc.

Contractor: Interactive Resources, Inc.

Operational Date:: December 1976

Total Estimated ERDA Funds: $35,154

Building
- Type: Film processing laboratory
- Area:

Location: Mill Valley, California

Latitude: 37.9°N

Climatic Data

Degree Days	Heating 2970	Cooling 530
Avg. Temp. (°F)	Winter 55.0	Summer 72.2
Avg. Insol.(Ly/d)	Winter 294	Summer 531

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓

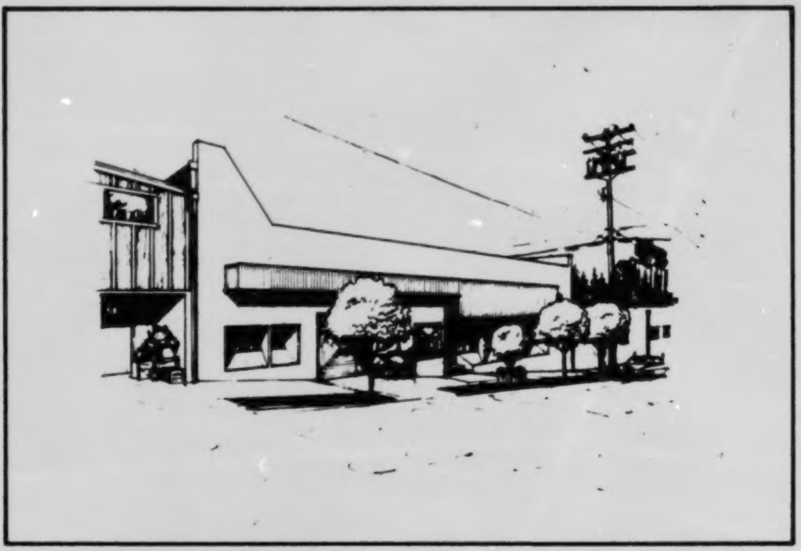
Collector
- Type: Flat-plate
- Area (sq. ft.): 640
- Manufacturer: Solar Utilities Co.

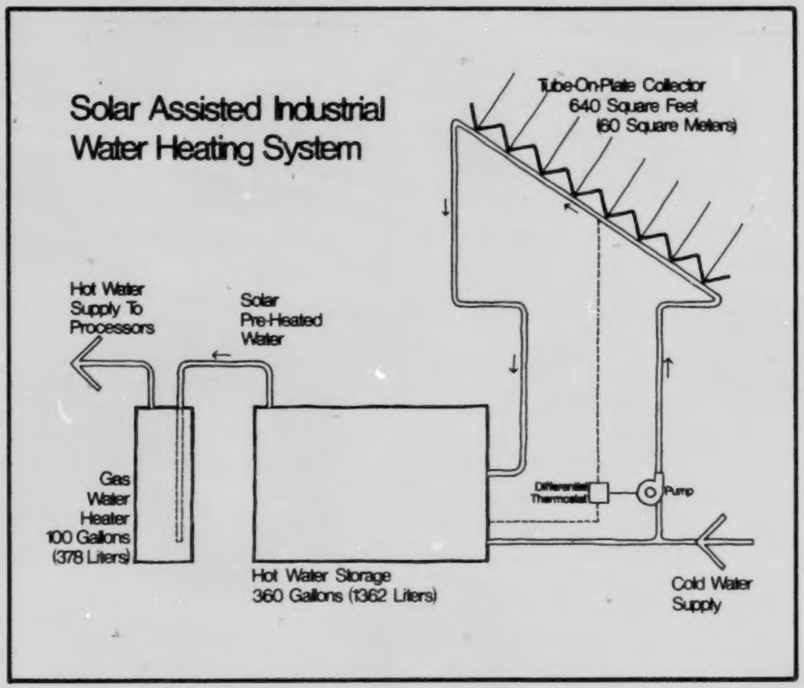
Storage
- Type: Water
- Capacity: 360 gallons

Auxiliary System Type: Gas-fired water heater

PROJECT DESCRIPTION

The project involves the application of a solar water heating system for an industrial film process application. The lab's four photo processors require a peak 12 gallons per minute of 100°F water, and an average load of six gallons per minute is anticipated. An expected 59% of this heating requirement will be provided by the solar collectors which are fabricated on site and mounted on tilted decks atop the flat roof. The collectors are made up of water cooled copper tubes with aluminum fins. Water is circulated from an insulated storage tank, the water circulating only when the collectors are warmer than the stored water. The solar storage tank feeds a conventional water heater under normal city water pressure. The average rate of auxiliary energy used for heating hot water should be no greater than 129,000,000 BTU/month. The system has been designed to allow for public viewing without disturbing the operation of the lab.




Solar Assisted Industrial Water Heating System
Tube-On-Plate Collector 640 Square Feet (60 Square Meters)
Hot Water Supply To Processors
Solar Pre-Heated Water
Gas Water Heater 100 Gallons (378 Liters)
Differential Thermostat
Pump
Hot Water Storage 360 Gallons (1362 Liters)
Cold Water Supply

PROJECT INFORMATION

Owner/Builder: Storek & Storek/Environmental Center

Contractor: Berkeley Solar Group

Operational Date: August 1977

Total Estimated ERDA Funds: $138,866

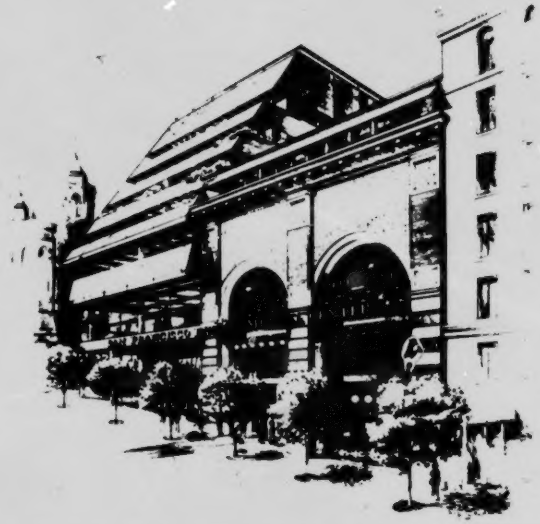
Building
Type: Office
Area: 100,000 sq.ft.

Location: San Francisco, California

Latitude: 37.5°N

Climatic Data

Degree Days	Heating	443	Cooling	
Avg. Temp. (°F)	Winter	51	Summer	59
Avg. Insol.(Ly/d)	Winter		Summer	



SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

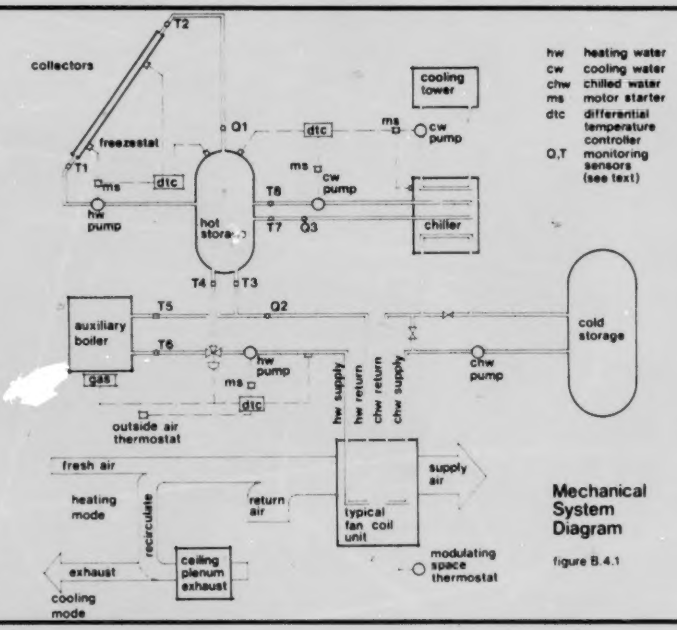
Collector
Type: Flat-plate
Area (sq. ft.): 1,800
Manufacturer: To be determined

Storage
Type: Water
Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

An obsolete downtown power generating plant built in 1916 is being reconstructed as an energy-efficient office building to be known as the San Francisco Environmental Center. The Center will be headquarters for environmental organizations and a public environmental education center serving the Bay Area. The windows supply 23% of the annual energy delivered to the building for space heating, the solar collectors 57%, and auxiliary systems 20%. Energy conservation features include lighting, HVAC, elevator, and envelope design innovations as well as lowered temperature standards. Solar space heating will be effected by flat plate collectors and a system of variable reflective/absorbent window blinds.


collectors
T2
T1
freezestat
ms
dtc
hw pump
Q1
hot storage
T8
T7
Q3
T4
T3
ms
cw pump
cooling tower
chiller
auxiliary boiler
gas
T5
T6
Q2
hw pump
ms
dtc
outside air thermostat
hw supply
hw return
chw return
chw supply
chw pump
cold storage
fresh air
heating mode
recirculate
return air
typical fan coil unit
supply air
exhaust
cooling mode
ceiling plenum exhaust
modulating space thermostat
hw heating water
cw cooling water
chw chilled water
ms motor starter
dtc differential temperature controller
Q,T monitoring sensors (see text)

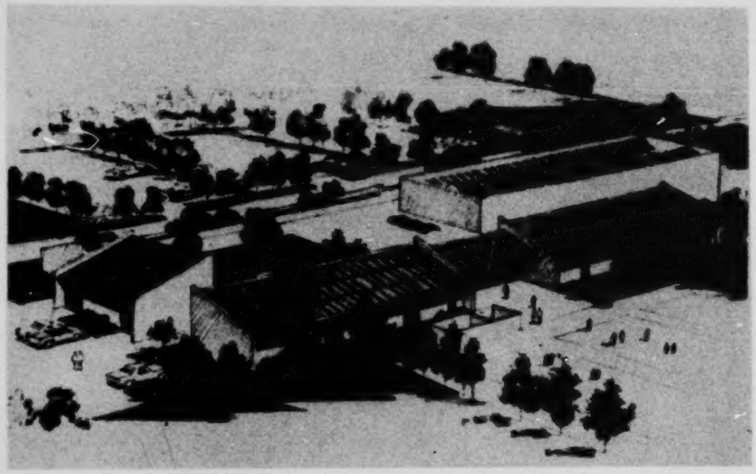
Mechanical System Diagram

figure B.4.1

PROJECT INFORMATION

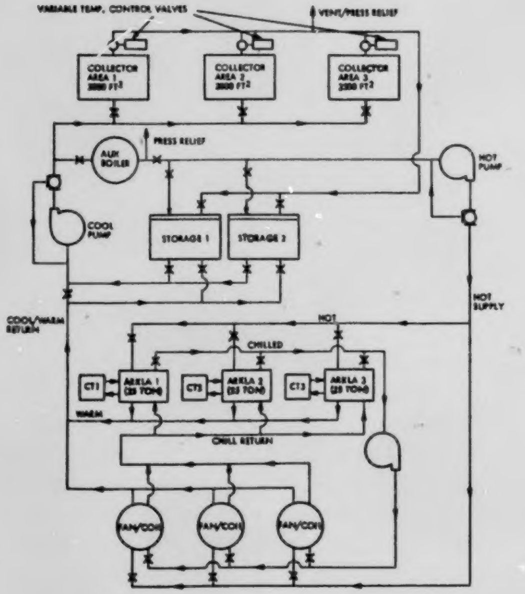
Owner/Builder: City of Santa Clara
Contractor: City of Santa Clara
Operational Date: September 1976
Total Estimated ERDA Funds: $670,000
Building
  Type: Community center
  Area: 27,000 sq.ft.
Location: Santa Clara, California
Latitude: 37.3°N
Climatic Data

Degree Days	Heating	2943	Cooling	647
Avg. Temp. (°F)	Winter	54.6	Summer	67.6
Avg. Insol.(Ly/d)	Winter	308	Summer	545



SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 80% Hot Water ✓
Collector
  Type: Copper absorber flat-plate
  Area (sq. ft.): 6,976
  Manufacturer: AMETEK, Inc.
Storage
  Type: Water
  Capacity: 60,000 gallons
Auxiliary System Type: Gas fired boiler


VARIABLE TEMP. CONTROL VALVES
VENT/PRESS RELIEF
COLLECTOR AREA 1 2000 FT²
COLLECTOR AREA 2 2600 FT²
COLLECTOR AREA 3 2300 FT²
PRESS RELIEF
AUX BOILER
HOT PUMP
COOL PUMP
STORAGE 1
STORAGE 2
HOT SUPPLY
COOL/WARM RETURN
HOT
CHILLED
CT1
ARKLA 1 (25 TON)
CT2
ARKLA 2 (25 TON)
CT3
ARKLA 3 (25 TON)
WARM
CHILL RETURN
FAN/COIL
FAN/COIL
FAN/COIL

PROJECT DESCRIPTION

The city of Santa Clara generates its own electric power and expects its requirement for electric power to double in the next six years. To reduce the growth of its energy demand, the city will design, procure, install, test, and operate a solar heating and cooling system for the community center. The system will have two ARKLA 25-ton LI-BR absorption chillers, and the building will have non-insulated 8-in. thick concrete block walls. The technical, legal, and financial feasibility of the system will be examined. Cost and performance data will be analyzed to determine whether solar energy can be used to lessen the demand for electric power. The city already provides solar heating services for several privately owned swimming pools. This project will demonstrate the feasibility of solar energy as a public utility.

PROJECT INFORMATION

Owner/Builder: Lake Valley Fire District

Contractor: John Brooks Boyd Assoc./Wm. E. Harlow

Operational Date: September 1976

Total Estimated ERDA Funds: $4,726

Building
  Type: Fire station
  Area: 3,100 sq.ft.

Location: South Lake Tahoe, California

Latitude: 38.9°N

Climatic Data

Degree Days	Heating 8100	Cooling 492
Avg. Temp. (°F)	Winter 20	Summer 60
Avg. Insol.(Ly/d)	Winter 372	Summer 693

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

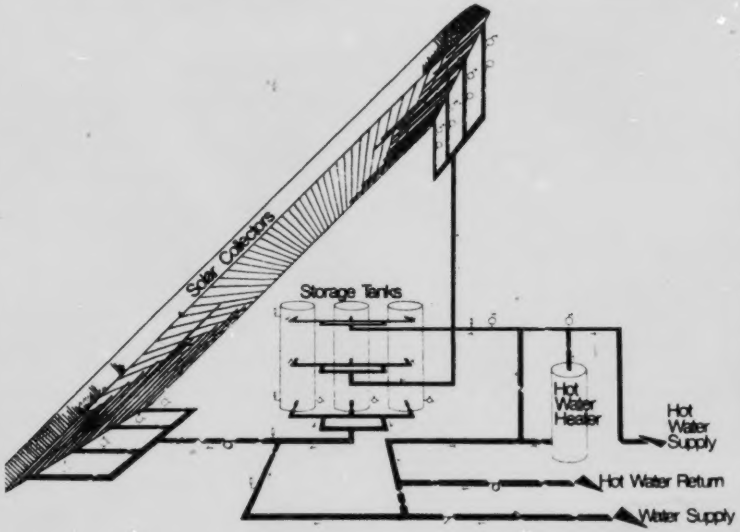
Collector
  Type: Copper flat-plate
  Area (sq. ft.): 352
  Manufacturer: Western Energy, Inc.

Storage
  Type: Water
  Capacity: 1,937 gallons

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

Solar energy will provide heat and hot water for the interior of the newly constructed Lake Valley Firehouse No. 2, also known as the Montgomery Estates Fire Station. This includes the firemen's living quarters and the engine room. In winter, solar heated water will be used to melt snow on the driveway of the station. Performance monitoring of the solar system will be carried out by the fire station personnel. This project should result in a reduction of operational costs. If this project is successful, a retrofit system for Lake Valley's main station will be considered. There are no other public facilities currently utilizing solar energy in this region; this project will serve as a model to county, city, and special districts considering potential solar projects.



38

39

PROJECT INFORMATION

Owner/Builder: Fredricks Development Corp.

Contractor: Southern California Gas Co.

Operational Date: Mid 1976

Total Estimated ERDA Funds: $391,900 (includes El Toro project)

Building
  Type: Apartments (40 units)
  Area: 57,600 sq.ft.

Location: Upland, California

Latitude: 34.1°N

Climatic Data

Degree Days	Heating	1282	Cooling	1215
Avg. Temp. (°F)	Winter	76.3	Summer	59.6
Avg. Insol.(Ly/d)	Winter	390	Summer	561

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓

Collector
  Type: Steel absorber flat-plate w/copper waterways
  Area (sq. ft.):
  Manufacturer: Lennox Industries-Honeywell Inc.

Storage
  Type:
  Capacity:

Auxiliary System Type: Gas boiler

PROJECT DESCRIPTION

In this project, a solar assisted gas water heater will be installed during the construction of an apartment building in Upland, California. Data on system cost, installation, and performance will be collected. It will be used for technical and financial studies of the project, with particular emphasis being placed on determining optimum implementation procedures. The solar collector used in this project consists of a copper absorber plate with integral steel waterways and a selective absorber coating (black chrome) with single low iron glazing. The building will have copper piping to carry heat transfer fluid to and from the solar collectors. The emphasis in this project is on cost effectiveness, and system components were chosen with that in mind. Cost data from this project and others like it will be valuable, because it will help potential investors to determine the favorable and unfavorable aspects of investment in solar energy systems for multiple unit buildings. This project was funded by the National Science Foundation. ERDA maintains technical cognizance.

Picture not available

Solar system sketch not available

PROJECT INFORMATION

Owner/Builder: State of Connecticut

Contractor: Dept. of Community Affairs

Operational Date: December 1976

Total Estimated ERDA Funds: $389,000

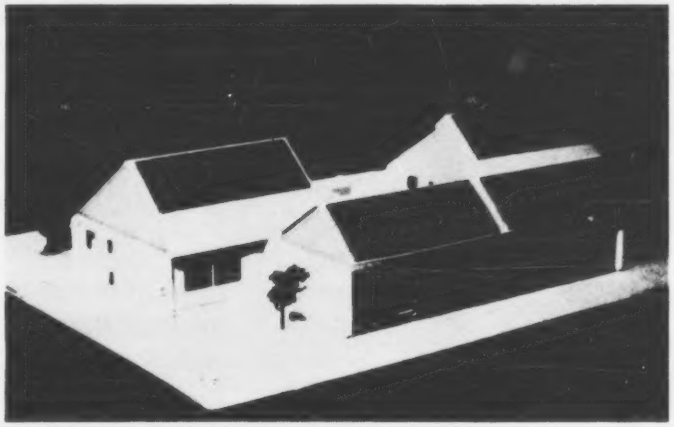
Building
  Type: Multi-family elderly housing
  Area: 16,800 sq.ft.(total); 8,400(cond.)

Location: Hamden, Connecticut

Latitude: 41.4°N

Climatic Data

Degree Days	Heating 5461	Cooling 735
Avg. Temp. (°F)	Winter 42.8	Summer 71.5
Avg. Insol.(Ly/d)	Winter 283	Summer 523



SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water ✓

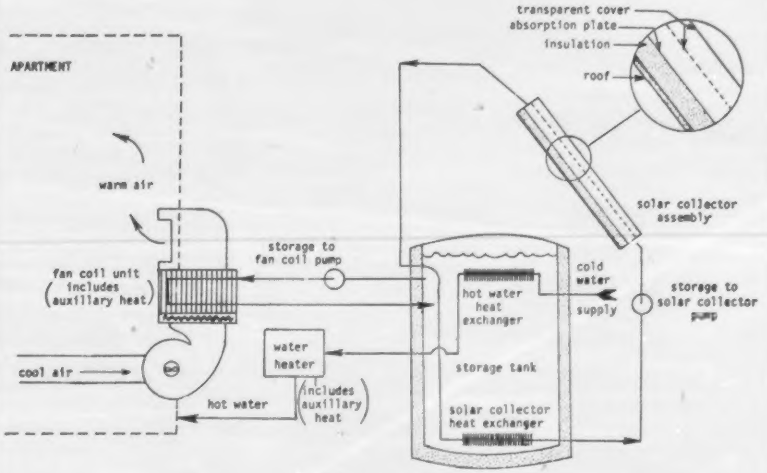
Collector
  Type: Liquid cooled flat-plate
  Area (sq. ft.): 2,600
  Manufacturer:

Storage
  Type: Water
  Capacity: 8,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This experiment will test the practicality and economy of using solar energy and other energy conservation techniques in housing for the elderly. The proposed project will consist of 40 housing units in low-rise structures. All will be designed for energy conservation. Half of the 40 units will be equipped with solar space and water heating and half will serve as a control in order that accurate conclusions on life cycle costs and performance may be drawn. A questionnaire will be used to determine how effective the tenants consider the solar energy system. The application will be a prototype for future state-assisted projects. The design and construction process will be integrated as closely as possible into the guidelines and procedures of Connecticut's Department of Community Affairs' (DCA) ongoing elderly housing program. As with all DCA elderly projects, the site will be acquired, the construction contract will be let, and the project will be owned and managed by a local housing authority.


transparent cover
absorption plate
insulation
roof
APARTMENT
warm air
solar collector assembly
storage to fan coil pump
fan coil unit (includes auxillary heat)
cold water supply
hot water heat exchanger
storage to solar collector pump
water heater
storage tank
cool air
hot water
(includes auxillary heat)
solar collector heat exchanger

PROJECT INFORMATION

Owner/Builder: Lutz-Sotire Partnership
Contractor: Wormser Scientific Corp.
Operational Date: October 1977
Total Estimated ERDA Funds: $335,000
Building
  Type: Office
  Area: 25,000 sq.ft. (conditioned)
Location: Stamford, Connecticut
Latitude: 41.1°N
Climatic Data

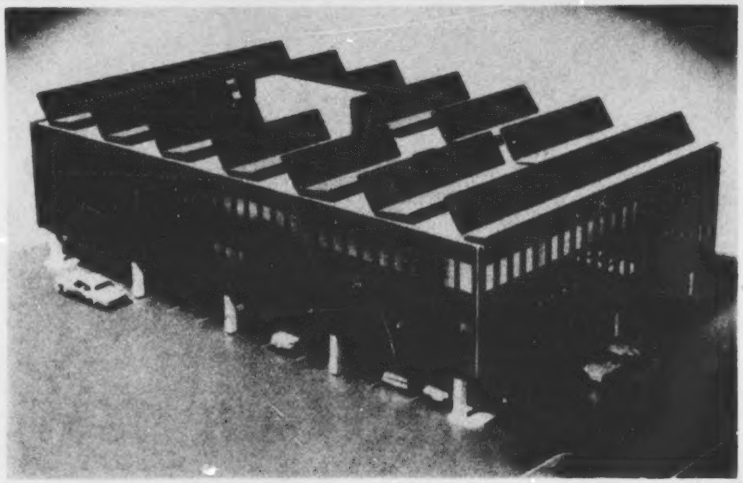
Degree Days	Heating	5461	Cooling	735
Avg. Temp. (°F)	Winter	42.8	Summer	70.2
Avg. Insol.(Ly/d)	Winter	284	Summer	489

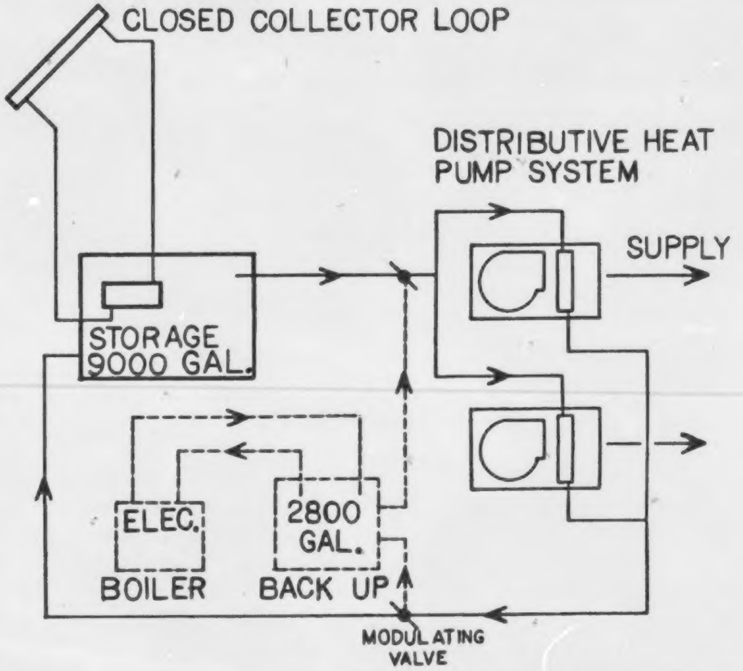
SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%
Collector
  Type: Selectively blackened copper flat-plate
  Area (sq. ft.): 3,174
  Manufacturer: Sunworks
Storage
  Type: Water
  Capacity: 9,000 gallons
Auxiliary System Type: Electric Boiler

PROJECT DESCRIPTION

For this project, the conventional space heating system of an office building in Stamford, Connecticut will be supplemented by a solar energy heating system. The building has three floors and is presently heated by electricity. The building offers two particular advantages for the proposed project. First, its closed loop, multiple heat pump system can be easily adapted for use with a solar energy source. Second, detailed records of energy consumption have been kept for the building over the past three years. These records could be used in comparing energy costs for the building before and after the installation of the solar energy system. The building is also physically suited to the installation of such a system. Two major pieces of equipment would be necessary, a solar collector and a storage tank. The building roof is flat and unobstructed; the solar collector could be installed there without difficulty. The storage tank could be easily installed at the rear of the building, beneath the present parking lot.





PROJECT INFORMATION

Owner/Builder: Dade County

Contractor: University of Miami

Operational Date: To be determined

Total Estimated ERDA Funds: $224,652 (conceptual studies)

Building
 Type: Elementary school
 Area: 60,000 sq.ft.

Location: Coral Gables, Florida

Latitude: 25.8°N

Climatic Data

Degree Days	Heating 206	Cooling 4038
Avg. Temp. (°F)	Winter 67.8	Summer 78.0
Avg. Insol.(Ly/d)	Winter 357	Summer 480

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 70 Hot Water ✓

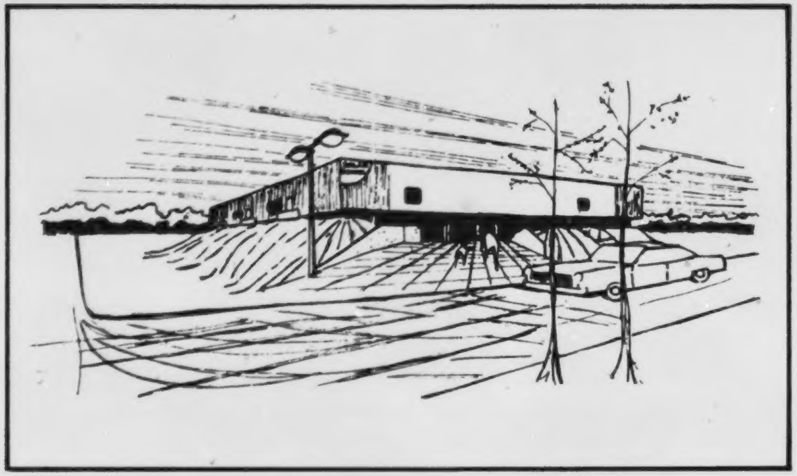
Collector
 Type: To be determined
 Area (sq. ft.):
 Manufacturer:

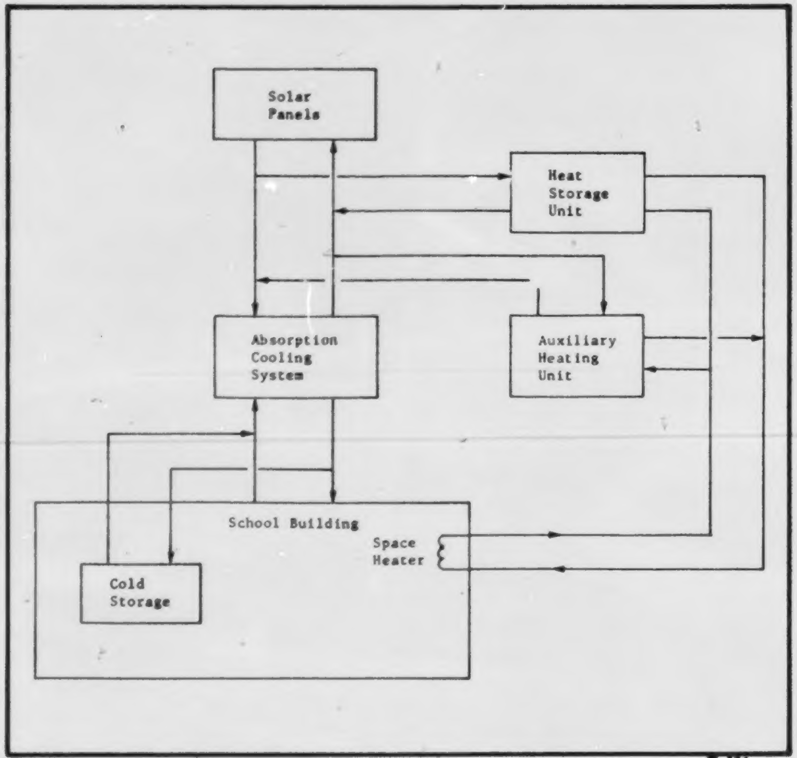
Storage
 Type: To be determined
 Capacity:

Auxiliary System Type: To be determined

PROJECT DESCRIPTION

The objective of this project is to develop an economically, socially, and aesthetically viable solar-powered heating and cooling system for an elementary school located in a subtropical region of the U.S. Research consisted of thermally and structurally optimizing building design and studying various mechanical/electrical subsystems. These subsystems include solar collectors, energy storage components, and air conditioning/heating equipment. To arrive at design recommendations for a prototype solar school, six basic design schemes were considered — a retrofit study of an existing school design, four studies of new or nonconventional energy-derived building forms and a study of a more conventional building design modified with energy-derived concepts. The drawing and schematic shown are representative of one of these design forms.





PROJECT INFORMATION

Owner/Builder: Reedy Creek Util. (Walt Disney Prod.)
Contractor:
Operational Date: May 1977
Total Estimated ERDA Funds: $326,000
Building
  Type: Office
  Area: 5,120 sq.ft. (conditioned)
Location: Lake Buena Vista, Florida
Latitude: 28.4°N
Climatic Data

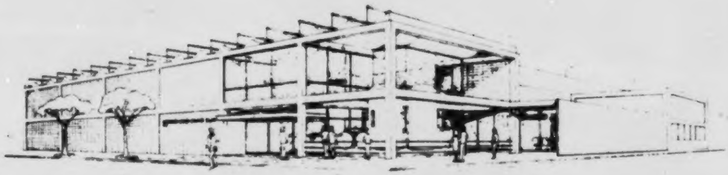
Degree Days	Heating	733	Cooling	3226
Avg. Temp. (°F)	Winter	61.1	Summer	75.3
Avg. Insol.(Ly/d)	Winter	315	Summer	475

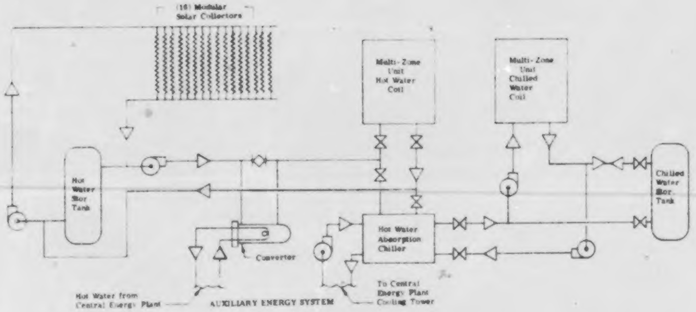
SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓
Collector
  Type: Modular cylindrical concentrator
  Area (sq. ft.): 3,840
  Manufacturer: AAI Corporation
Storage
  Type: Water
  Capacity: 16,500 gallons
Auxiliary System Type: Electric

PROJECT DESCRIPTION

The project involves a two-story concrete and block office addition to Disney World's Central Energy Plant. This insulated building contains a solar equipment room which will be showcased for high visibility. Sixteen modular solar collectors are joined together along the ridge lines to form the insulated roof. The longitudinal axes of the reflective surface run in an east-west direction. The solar roof replaces the usual trusses, corrugated decking, and insulating concrete roof. This reduces the costs associated with conventional roofing. Each 8 ft. by 32 ft. modular collector is a solar concentrator that consists of a concave cylindrical reflective surface and an absorber. The absorber uses water as a heat transfer medium and is kept in focus with the reflective surface by a linear actuator controlled by a sun sensor/focusing device.




(16) Modular Solar Collectors
Multi-Zone Unit Hot Water Coil
Multi-Zone Unit Chilled Water Coil
Hot Water Stor. Tank
Chilled Water Stor. Tank
Converter
Hot Water Absorption Chiller
Hot Water from Central Energy Plant
AUXILIARY ENERGY SYSTEM
To Central Energy Plant Cooling Tower

PROJECT INFORMATION

Owner/Builder: Florida Dept. of Commerce
Contractor: Florida Dept. of General Services
Operational Date: June 1977
Total Estimated ERDA Funds: $347.812

Building
  Type: Welcome station
  Area: 3,300 sq.ft. (conditioned)

Location: Nassau County, Florida
Latitude: 30.7°N

Climatic Data

Degree Days	Heating 1327	Cooling 2596
Avg. Temp. (°F)	Winter 57.7	Summer 76.0
Avg. Insol.(Ly/d)*	Winter 308	Summer 496

SOLAR ENERGY SYSTEM

Application Heating 99% Cooling 88% Hot Water 0%

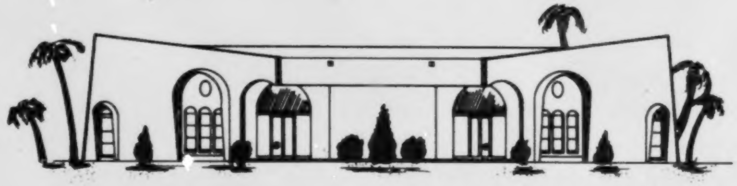
Collector
  Type: Fresnel Lens, concentrating and tracking
  Area (sq. ft.): 2,700
  Manufacturer: Northrup, Inc.

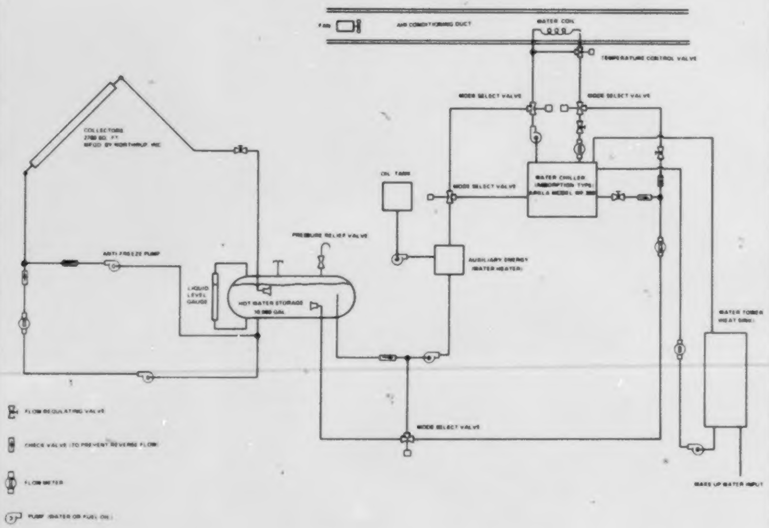
Storage
  Type: Water
  Capacity: 10,000 gallons

Auxiliary System Type: Oil fired furnace

PROJECT DESCRIPTION

This Florida Welcome Station, located on Interstate 95 two miles south of the Florida-Georgia line, is expected to accommodate a large number of visitors. To conserve energy, the one-story building utilizes a poured, light-weight, aggregate roof deck; a suspended insulating tile ceiling; and windows that are protected from direct sunlight. Key system components include a 25-ton ARKLA WF-300 absorption chiller, a field of concentrating collectors, a hot water storage tank and a cooling tower that will provide condensing water. An oil-fired hot water heater, a vapor compression air exchange air conditioner, and an oil-fired furnace will be the auxiliary systems. The building's energy system (solar and conventional) will be controlled by a single set of valves and sensors. Automatic switching between the two systems will be possible, manual operation being necessary only for selecting the heating or cooling mode.




FAN
AIR CONDITIONING DUCT
WATER COIL
TEMPERATURE CONTROL VALVE
MODE SELECT VALVE
MODE SELECT VALVE
COLLECTORS
2700 SQ. FT.
MFGD BY NORTHRUP INC
OIL TANK
MODE SELECT VALVE
WATER CHILLER
(ABSORPTION TYPE)
ARKLA MODEL WF 300
PRESSURE RELIEF VALVE
ANTI FREEZE PUMP
AUXILIARY ENERGY
(WATER HEATER)
LIQUID
LEVEL
GAUGE
HOT WATER STORAGE
10,000 GAL
WATER TOWER
(HEAT SINK)
MODE SELECT VALVE
FLOW REGULATING VALVE
CHECK VALVE (TO PREVENT REVERSE FLOW)
FLOW METER
PUMP (WATER OR FUEL OIL)
MAKE UP WATER INPUT

PROJECT INFORMATION

Owner/Builder: City of Atlanta

Contractor: Westinghouse Electric Co.

Operational Date: September 1975

Total Estimated ERDA Funds: $912,000

Building
- Type: Elementary school
- Area: 32,000 sq.ft.

Location: Atlanta, Georgia

Latitude: 33.8°N

Climatic Data

Degree Days	Heating 3095	Cooling 1589
Avg. Temp. (°F)	Winter 51.0	Summer 74.5
Avg. Insol.(Ly/d)	Winter 312	Summer 508

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 60% Hot Water 80%

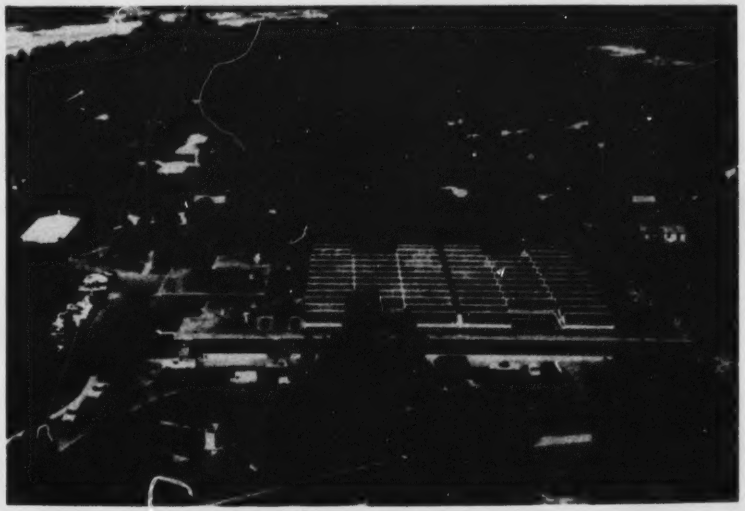
Collector
- Type: Aluminum rollbond liquid flat-plate/reflector
- Area (sq. ft.): 10,360/10,800
- Manufacturer: Pittsburgh Plate Glass, Inc.

Storage
- Type: Inhibited water
- Capacity: 45,000 gallons

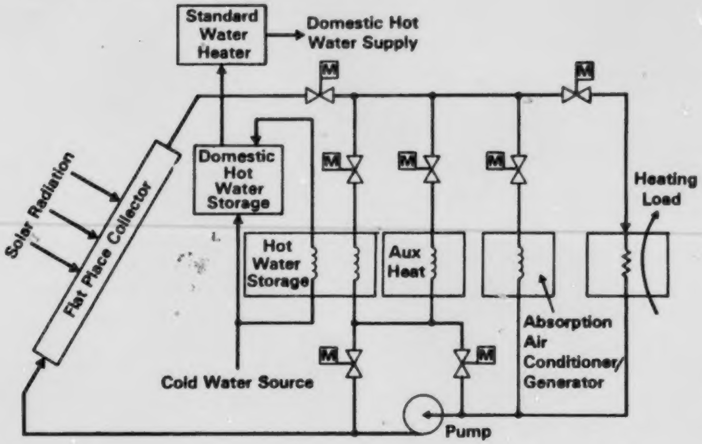
Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

In this project, the George A. Towns Elementary School in Atlanta, Ga. was provided with a solar energy system for space heating and cooling as well as for hot water heating. The school's original heating and cooling system was retrofitted for use with a solar energy source. The solar energy system included a collector/reflector array mounted on the school's roof, three 15,000-gallon thermal storage tanks, and a 100-ton ARKLA absorption chiller. Besides reducing energy consumption, the solar energy system will provide data on several critical points – the performance of the mass-produced collectors, for instance, and the system's capacity to function under high temperatures (200°F).



Solar Heating and Cooling System


Standard Water Heater
Domestic Hot Water Supply
M
Domestic Hot Water Storage
Solar Radiation
Flat Plate Collector
Hot Water Storage
Aux Heat
Heating Load
Absorption Air Conditioner/Generator
Cold Water Source
Pump

PROJECT INFORMATION

Owner/Builder: Town of Shenandoah

Contractor: Georgia Institute of Technology

Operational Date: January 1977

Total Estimated ERDA Funds: $727,000

Building
- Type: Community center
- Area: 55,000 sq.ft.(total); 35,000(cond.)

Location: Shenandoah, Georgia

Latitude: 33.6°N

Climatic Data

Degree Days	Heating 3095	Cooling 1589
Avg. Temp. (°F)	Winter 51.0	Summer 74.6
Avg. Insol.(Ly/d)	Winter 312	Summer 508

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 60% Hot Water 90%

Collector
- Type: Copper flat-plate/reflector
- Area (sq. ft.): 10,500/14,000
- Manufacturer: Revere Copper & Brass

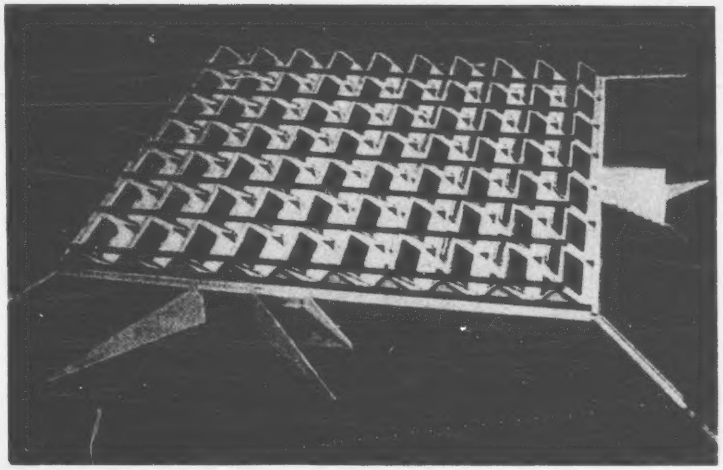
Storage
- Type: Water
- Capacity: 75,000 gallons

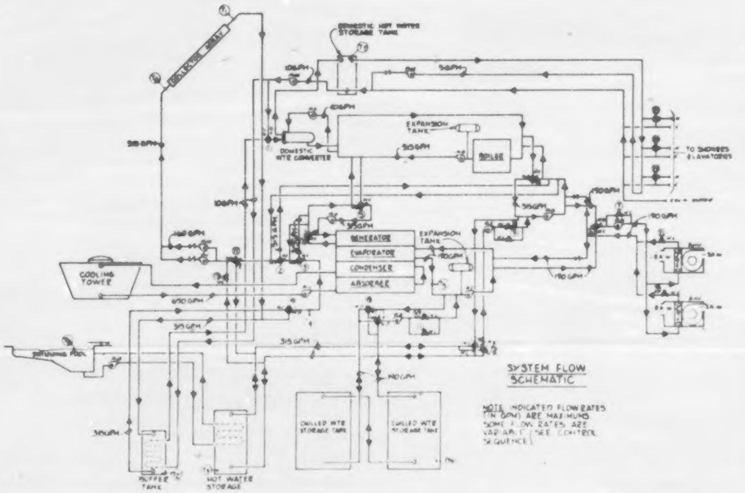
Auxiliary System Type:

PROJECT DESCRIPTION

The Georgia Institute of Technology has designed and computer-modeled this multipurpose community center for the new town of Shenandoah, approximately 25 miles south of Atlanta. The building is partially underground incorporating numerous energy conserving features. 14,000 sq. ft. of polished aluminum reflectors augment the rooftop solar collectors for additional heat input during the summer months. The individual 21 ft. by 8 ft. solar collector modules are factory-assembled for low-cost rooftop installation. Air conditioning will be provided by a 100-ton lithium bromide absorption chiller. In the autumn and spring, heat from the solar collectors which is not needed for space heating, cooling, or hot water will be used to heat an outdoor olympic-sized swimming pool.

54




DOMESTIC HOT WATER STORAGE TANK
DOMESTIC WTR CONVERTER
EXPANSION TANK
BOILER
TO SHOWERS ELAVATORIES
GENERATOR
EVAPORATOR
CONDENSER
ABSORBER
COOLING TOWER
SWIMMING POOL
BUFFER TANK
HOT WATER STORAGE
CHILLED WTR STORAGE TANK
CHILLED WTR STORAGE TANK
315 GPM
100 GPM
190 GPM
650 GPM
SYSTEM FLOW SCHEMATIC
NOTE: INDICATED FLOW RATES (IN GPM) ARE MAXIMUMS. SOME FLOW RATES ARE VARIABLE (SEE CONTROL SEQUENCE).

55

PROJECT INFORMATION

Owner/Builder: Scattergood School

Contractor: Modern Metals, Inc.

Operational Date: September 1976

Total Estimated ERDA Funds: **$76,289**

Building
- Type: School gymnasium
- Area: 7,966 sq.ft.

Location: West Branch, Iowa

Latitude: 41.8°N

Climatic Data

Degree Days	Heating	7255	Cooling	800
Avg. Temp. (°F)	Winter	41.0	Summer	71.7
Avg. Insol.(Ly/d)	Winter	298	Summer	545

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 0% Hot Water 75%

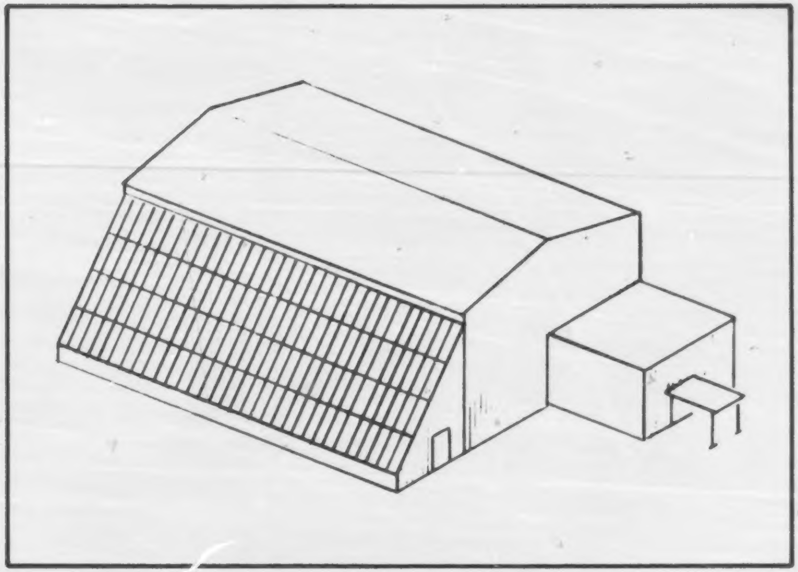
Collector
- Type: Air heating flat-plate
- Area (sq. ft.): 2,496
- Manufacturer: Solaron Corporation

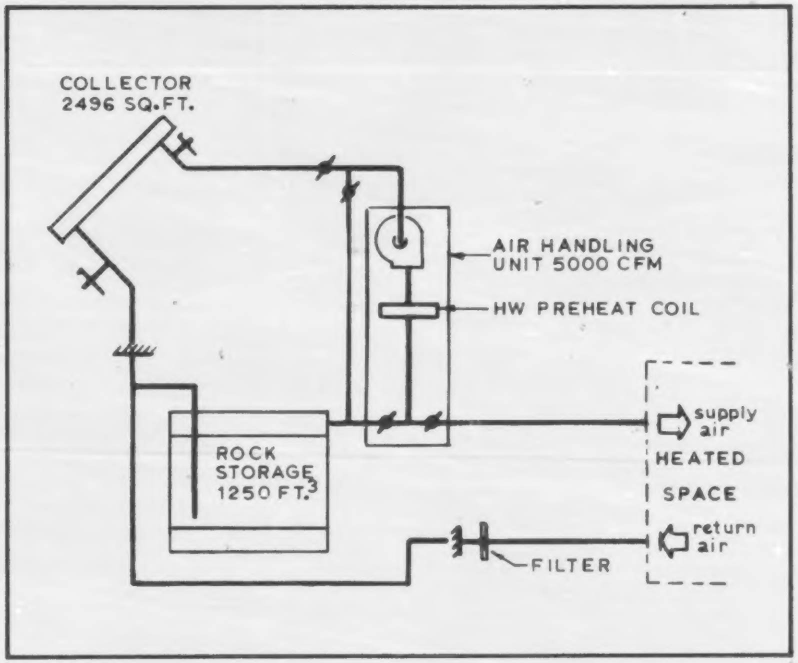
Storage
- Type: ¾" diameter rock
- Capacity: 1,250 cu.ft.

Auxiliary System Type: Gas fired unit heaters, gas furn.

PROJECT DESCRIPTION

The selected solar energy system for this school gymnasium is based on a prototype model which has been in continuous successful operation since 1957. The collector array, to be located against the south wall, will be a combination of factory preassembled modules 36 in. by 78 in. Each module has double tempered glass covers and a sheet steel absorber, with an air duct below the permanent black absorber surface. At the site, these modular collector panels are plugged into each other with a minimum of installation time. The metal building is pre-engineered with 6900 sq.ft. in the main portion and a 1066 sq.ft. utility storage and locker room addition. The anticipated structural heating/cooling load is 56,000 BTU per degree day.





PROJECT INFORMATION

Owner/Builder: Rademaker Corporation

Contractor:

Operational Date: October 1976

Total Estimated ERDA Funds: $20,729

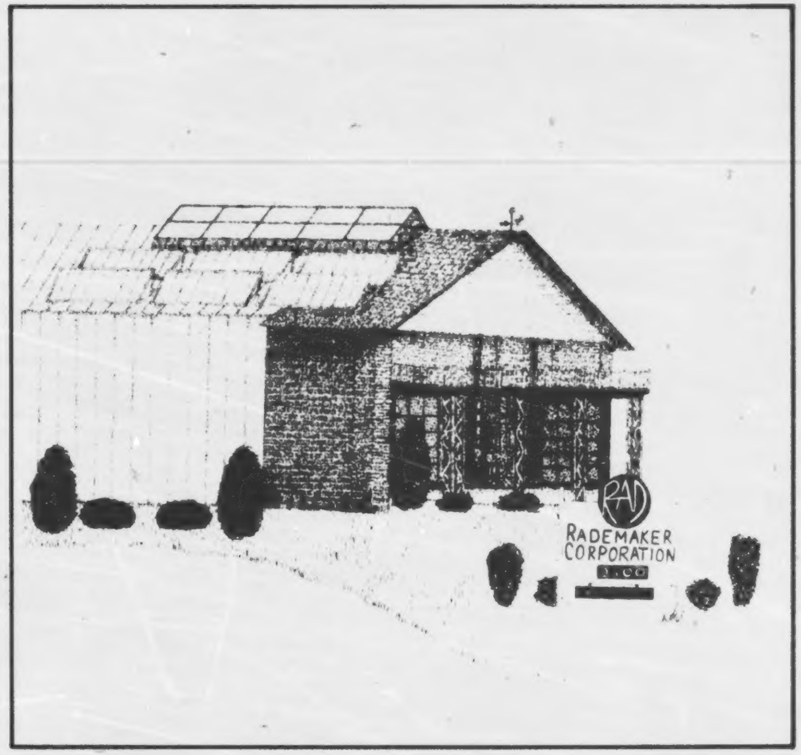
Building
  Type: Office/warehouse
  Area: 10,000 sq.ft.(total); 1,080 (cond.)

Location: Louisville, Kentucky

Latitude: 38.2°N

Climatic Data

Degree Days	Heating	4645	Cooling	1268
Avg. Temp. (°F)	Winter	46.2	Summer	73.2
Avg. Insol.(Ly/d)	Winter	287	Summer	504



SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

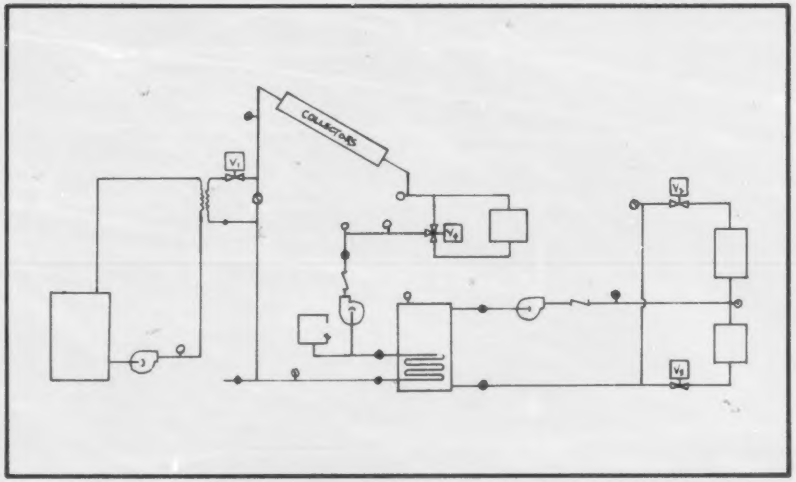
Collector
  Type: Air flat-plate/liquid heating flat-plate
  Area (sq. ft.): 195/240
  Manufacturer: Solaron Corporation/SDI

Storage
  Type: Rock and water
  Capacity: 110 cu.ft./560 gallons

Auxiliary System Type: Natural gas

PROJECT DESCRIPTION

Solar energy will provide heat for office space within a steel constructed Butler building. Waste energy produced in excess of that demanded by office area can be passed into the warehouse or second floor drafting room. Two systems are employed, a liquid heating system employing ethylene glycol through south facing collectors inclined at 53°, and an air collector system employing ten panels of 19 ½ sq.ft. The liquid system employs a heat exchanger built into the hot water storage tank, the exchanger allowing ethylene glycol to pump through the collectors when solar radiation is available. This introduces heat into the stored water. The air collector system employs eight motor operated dampers and a booster fan to introduce the air to the collectors and/or the rock storage bin. The air is then moved to the respective air handling system for distribution to the space.



PROJECT INFORMATION

Owner/Builder: Louisiana State U. & A&M College

Contractor:

Operational Date: September 1977

Total Estimated ERDA Funds: $258,225

Building

Type: Fieldhouse

Area: 101,200 sq.ft. (conditioned)

Location: Baton Rouge, Louisiana

Latitude: 30.7°N

Climatic Data

Degree Days	Heating	1560	Cooling	2585
Avg. Temp. (°F)	Winter	55.2	Summer	76.2
Avg. Insol.(Ly/d)	Winter	287	Summer	490

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

Collector

Type: Two cover, modular, selective absorber

Area (sq. ft.): 5,700

Manufacturer: Lennox Industries -Honeywell, Inc.

Storage

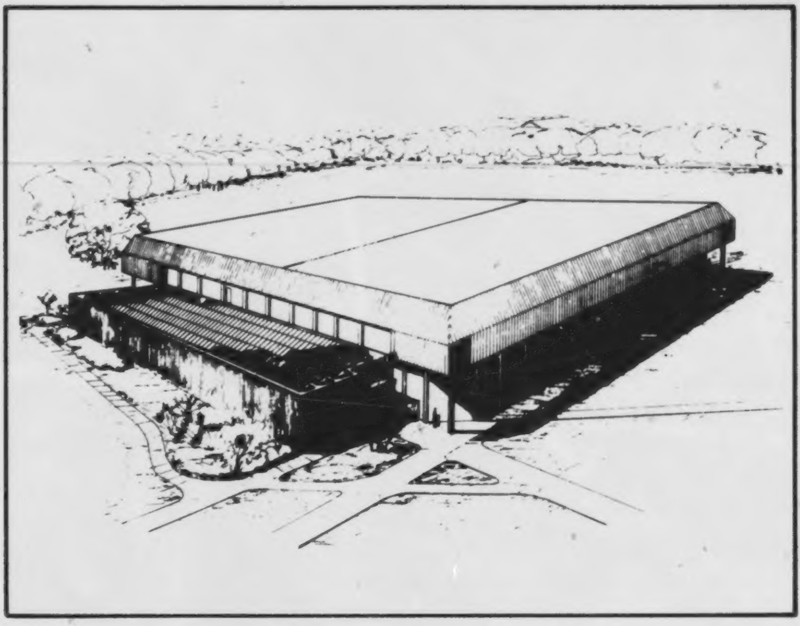
Type: Water

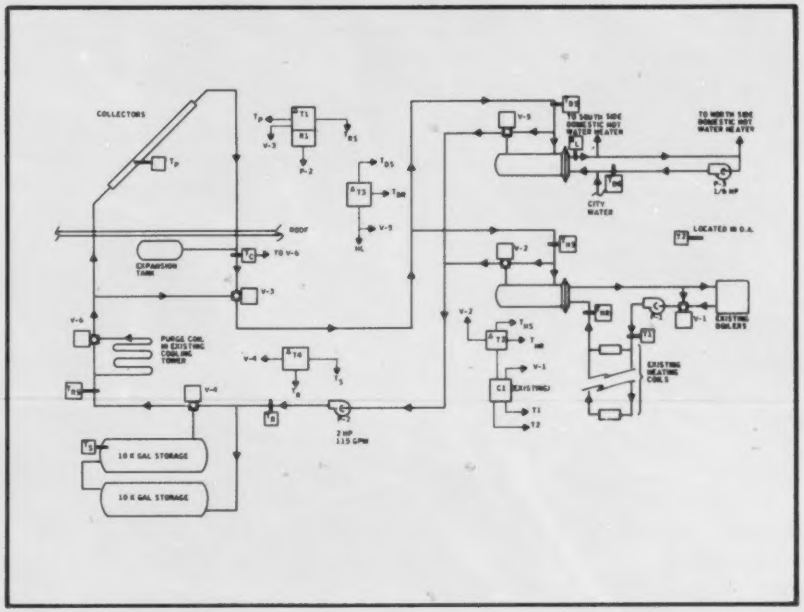
Capacity: 20,000 gallons

Auxiliary System Type: Gas-fired Boilers

PROJECT DESCRIPTION

An existing field house used year round by students and faculty for indoor athletics will be retrofitted with the proposed solar energy system. The field house consists of a one story center wing, a two story south wing, and a two story north wing. Exterior walls are 8-in. concrete, except the upper part of the center wing, which is plywood sheathing on light gage steel framing with glass fiber blanket insulation. Ceilings are insulated with brown cellulose acoustical-thermal insulation. Collectors are located on the roof of the south wing. The maximum domestic hot water requirement is 1600 gallons per hour. The solar system is designed to provide storage of heat equivalent to two days of peak solar radiation. The yearly sunshine received by Baton Rouge is approximately 57%.




COLLECTORS
T_P
T1
R1
V-3
P-2
T_{RS}
T_{DS}
T_{DR}
V-5
ROOF
EXPANSION TANK
T_C
TO V-6
V-3
V-6
PURGE COIL IN EXISTING COOLING TOWER
T_{RS}
V-4
T4
T_S
T_R
P-2
2 HP 115 GPM
10 K GAL STORAGE
10 K GAL STORAGE
T_{DS}
TO SOUTH SIDE DOMESTIC HOT WATER HEATER
TO NORTH SIDE DOMESTIC HOT WATER HEATER
CITY WATER
P-3 1/6 HP
LOCATED IN O.A.
T2
T_{HS}
V-2
T2
T_{HR}
V-1
C1 (EXISTING)
T1
T2
P-1
V-1
EXISTING BOILERS
EXISTING HEATING COILS

PROJECT INFORMATION

Owner/Builder: Ferguson Corporation
Contractor: Anthony F. Musolino
Operational Date: April 1977
Total Estimated ERDA Funds: $75,545
Building
  Type: Motel
  Area:
Location: Annapolis, Maryland
Latitude: 39.0°N

Climatic Data

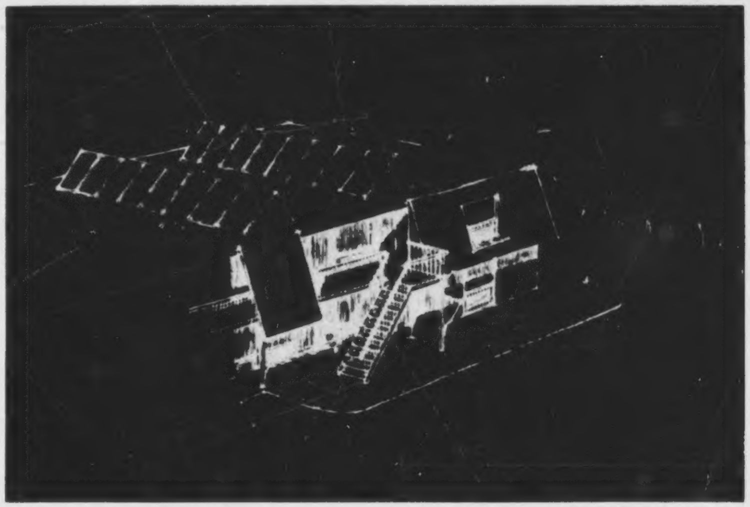
Degree Days	Heating 4729	Cooling 1108
Avg. Temp. (°F)	Winter 45.9	Summer 73.1
Avg. Insol.(Ly/d)	Winter 288	Summer 488

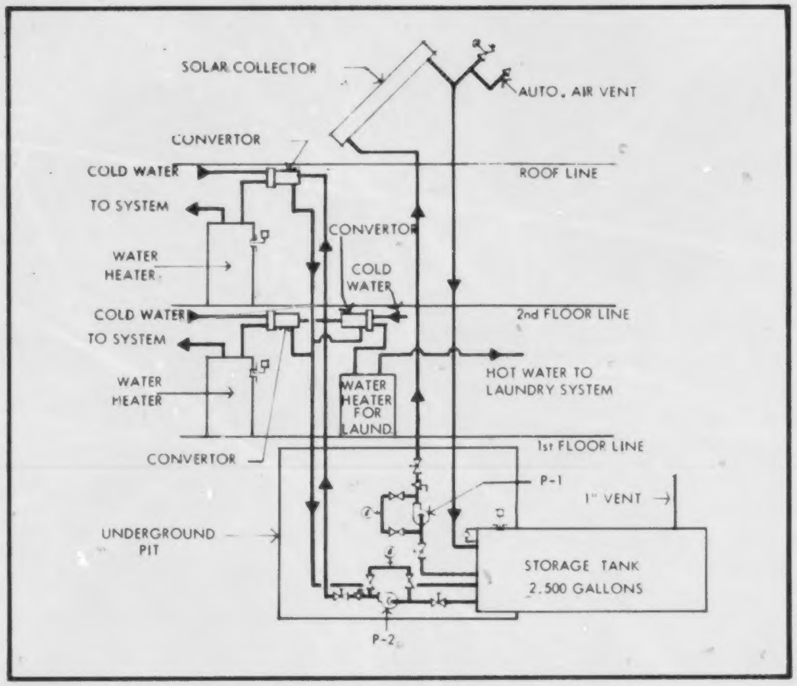
SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓
Collector
  Type: Flat-plate
  Area (sq. ft.): 2325
  Manufacturer: To be determined
Storage
  Type: Water
  Capacity: 3,500 gallons
Auxiliary System Type: Electric

PROJECT DESCRIPTION

In this project, the present water heating facilities of the Thr-rift Inn in Annapolis, Md. will be supplemented by a solar energy system. The motel currently uses electricity to heat its water, but a more economical system has become increasingly desirable. The motel offers two special challenges for a solar energy system. First, the demand in the rooms for hot water during non-daylight hours is quite high. Second, the motel has a laundry, which also has a very high hot water requirement. The proposed solar energy system uses solar collectors, a heat exchanger, and a storage tank. It will provide water heated to 120°F for the occupant use. The solar system will be supplemented by an electrical water heater for the laundry. The electric heater will raise the temperature of the water from 120°F to 180°F, the temperature required by Maryland State health codes.




SOLAR COLLECTOR
AUTO. AIR VENT
CONVERTOR
COLD WATER
ROOF LINE
TO SYSTEM
CONVERTOR
WATER HEATER
COLD WATER
COLD WATER
2nd FLOOR LINE
TO SYSTEM
WATER HEATER
WATER HEATER FOR LAUND.
HOT WATER TO LAUNDRY SYSTEM
1st FLOOR LINE
CONVERTOR
P-1
1" VENT
UNDERGROUND PIT
STORAGE TANK
2,500 GALLONS
P-2

Note: The solar domestic hot water system with the 1,000 gallon storage tank is similar in diagrammatic design with the exception that the laundry preheating system is omitted.

PROJECT INFORMATION

Owner/Builder: City of Baltimore

Contractor:

Operational Date: July 1977

Total Estimated ERDA Funds: $150,345

Building
  Type: Community Center
  Area: 17,000 sq.ft.

Location: Baltimore, Maryland

Latitude: 39.2°N

Climatic Data

Degree Days	Heating 4729	Cooling 1108
Avg. Temp. (°F)	Winter 45.9	Summer 73.1
Avg. Insol.(Ly/d)	Winter 288	Summer 488

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

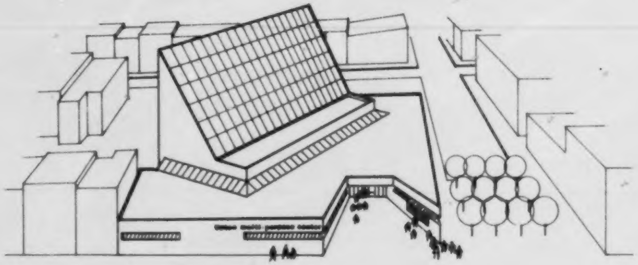
Collector
  Type: Copper water cooled flat-plate
  Area (sq. ft.): 3,840
  Manufacturer: Revere Copper & Brass

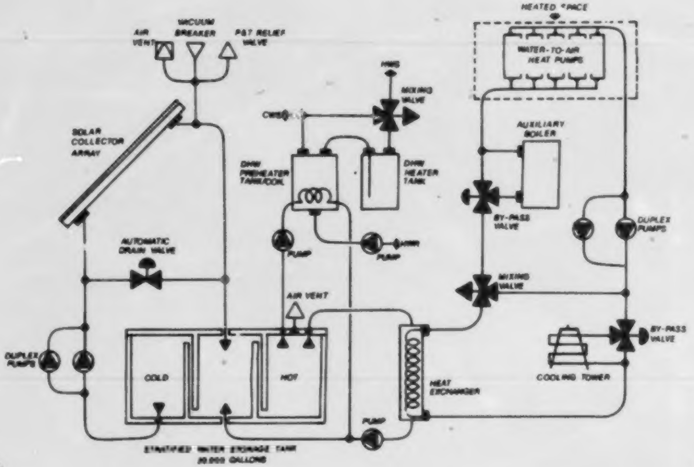
Storage
  Type: Water
  Capacity: 20,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

Located in the Upton Urban Renewal Area immediately northwest of the central business district of Baltimore, this building houses a daycare and recreation facility. The core of the facility is a steel-framed gymnasium with the single plane solar collector being integrated into the single-pitch roof structure. Hallway skylights provide light and passive solar heating. Thermal energy storage is accomplished with a built-in-place compartment concrete tank. Recessed double glazed windows and air-lock entry improve the thermal performance of the building. Freeze protection for the system will be through automatic drainage of the water when the collector temperature is either less than 60°F or 10 degrees less than the storage tank temperature for a period of two hours.




HEATED SPACE
AIR VENT
VACUUM BREAKER
P&T RELIEF VALVE
WATER-TO-AIR HEAT PUMPS
HWS
MIXING VALVE
CWS
SOLAR COLLECTOR ARRAY
AUXILIARY BOILER
DHW PREHEATER TANK/COIL
DHW HEATER TANK
BY-PASS VALVE
DUPLEX PUMPS
AUTOMATIC DRAIN VALVE
PUMP
PUMP
HWR
MIXING VALVE
AIR VENT
BY-PASS VALVE
DUPLEX PUMPS
COLD
HOT
HEAT EXCHANGER
COOLING TOWER
PUMP
STRATIFIED WATER STORAGE TANK
20,000 GALLONS

PROJECT INFORMATION

Owner/Builder: Baltimore County

Contractor: AAI Corporation

Operational Date: August 1977

Total Estimated ERDA Funds: $448,000

Building
  Type: Elementary school
  Area: 45,000 sq.ft.(total); 10,000(cond.)

Location: Cockeysville, Maryland

Latitude: 39.9°N

Climatic Data

Degree Days	Heating	4729	Cooling	1108
Avg. Temp. (°F)	Winter	45.9	Summer	73.1
Avg. Insol.(Ly/d)	Winter	288	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling 75% Hot Water 0%

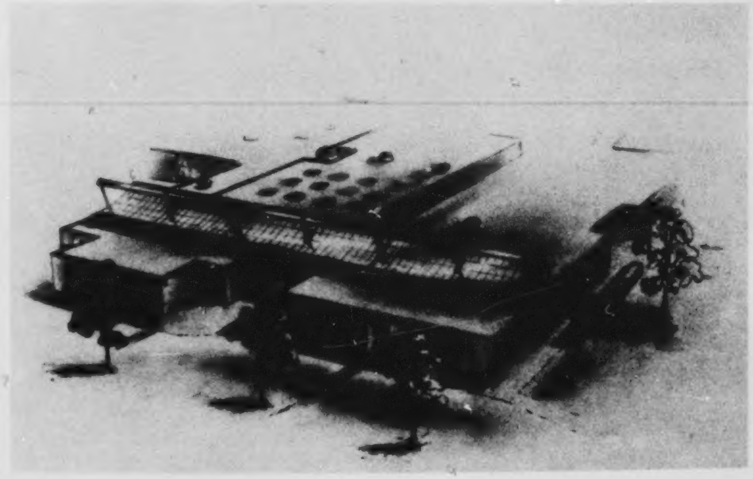
Collector
  Type: Liquid selective-coated concentrator/reflector
  Area (sq. ft.): 3,200/3,350
  Manufacturer: AAI Corporation

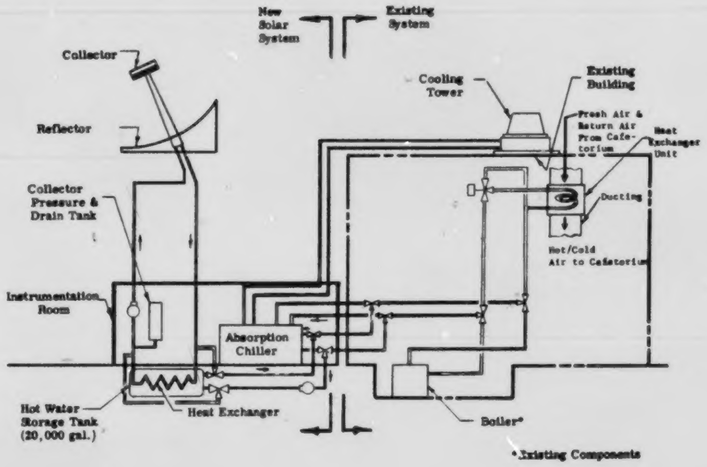
Storage
  Type: Water
  Capacity:

Auxiliary System Type: Oil and electric

PROJECT DESCRIPTION

The project encompasses the design, manufacture, retrofit installation, and testing of a solar concentrator for the one-story Padonia Elementary School. The concentrator provides most of the heating and cooling required for the cafetorium, library and administrative suite. The solar concentrator system consists of fixed parabolic reflector mirrors mounted on the south end of the school, a liquid collector with an electronic sun-sensing control mechanism, hot and cold water storage, and an absorption chiller. The performance of the collector will be closely monitored and compared with the performance of the flat-plate collector installation at the Timonium Elementary School located only two miles away.




New Solar System
Existing System
Collector
Reflector
Collector Pressure & Drain Tank
Instrumentation Room
Cooling Tower
Existing Building
Fresh Air & Return Air From Cafetorium
Heat Exchanger Unit
Ducting
Hot/Cold Air to Cafetorium
Absorption Chiller
Hot Water Storage Tank (20,000 gal.)
Heat Exchanger
Boiler*
*Existing Components

PROJECT INFORMATION

Owner/Builder: Md. National Cap. Park & Plan. Comm.

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: $49,016

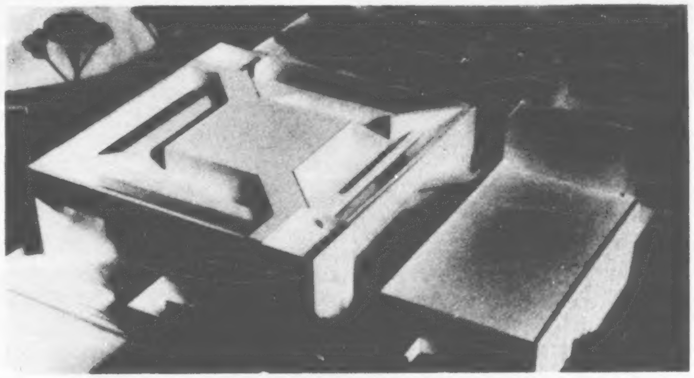
Building
  Type: Office addition
  Area: 22,264 sq.ft.

Location: Silver Spring, Maryland

Latitude: 39.0°N

Climatic Data

Degree Days	Heating	4211	Cooling	1415
Avg. Temp. (°F)	Winter	42.2	Summer	69.9
Avg. Insol.(Ly/d)	Winter	262	Summer	483



SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%

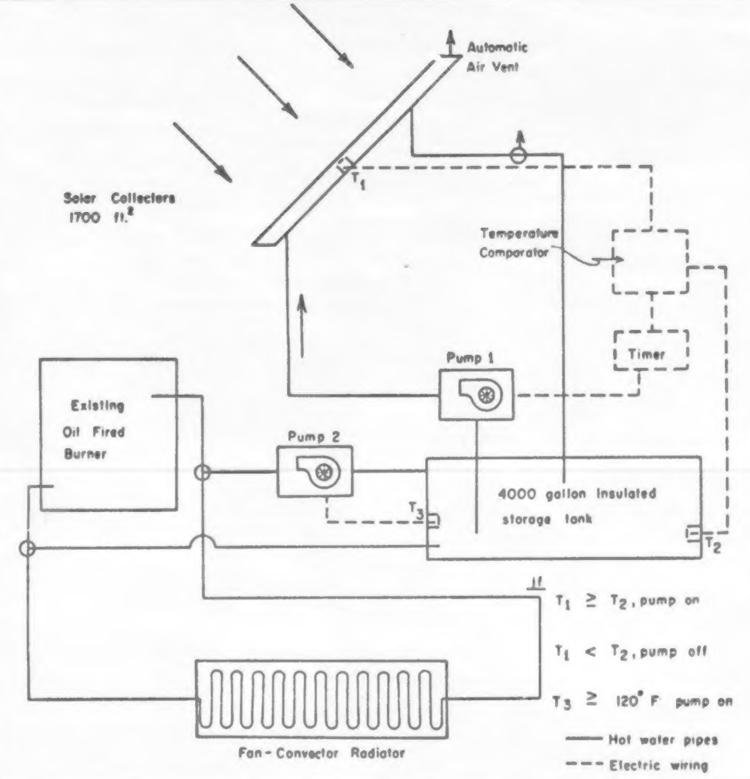
Collector
  Type: Double glazed flat-plate
  Area (sq. ft.): 1,700
  Manufacturer: To be determined

Storage
  Type: Water
  Capacity: 4,000 gallons

Auxiliary System Type: Oil-fired boiler

PROJECT DESCRIPTION

For this project, a solar energy system will provide heat to a three-story addition to an office building. The solar system will use collectors on the building roof, a heat exchanger, pump, and storage tank. It should provide 25% of the building's space heating requirement during peak demand periods and 100% of the requirement when demand is lowest. The building design calls for the extensive use of glass in the construction of the perimeter walls; but, because most of the glass will be triple glazed, it should provide insulation comparable to that provided by more conventional block wall construction. The use of glass in walls and skylights should significantly reduce electric lighting demands, since all floors, including the basement, will be provided with natural lighting. Trees and shrubs will be planted around the building in sufficient quantities that heating demands in winter and cooling demands in summer will both be significantly reduced.


Automatic Air Vent
Solar Collectors 1700 ft.²
T1
Temperature Comparator
Timer
Pump 1
Existing Oil Fired Burner
Pump 2
T3
4000 gallon insulated storage tank
T2
T1 ≥ T2, pump on
T1 < T2, pump off
T3 ≥ 120° F pump on
Hot water pipes
Electric wiring
Fan-Convector Radiator

PROJECT INFORMATION

Owner/Builder: Baltimore County

Contractor: AAI Corporation

Operational Date: March 1974(heating); May 1975(cooling)

Total Estimated ERDA Funds: $1,114,000

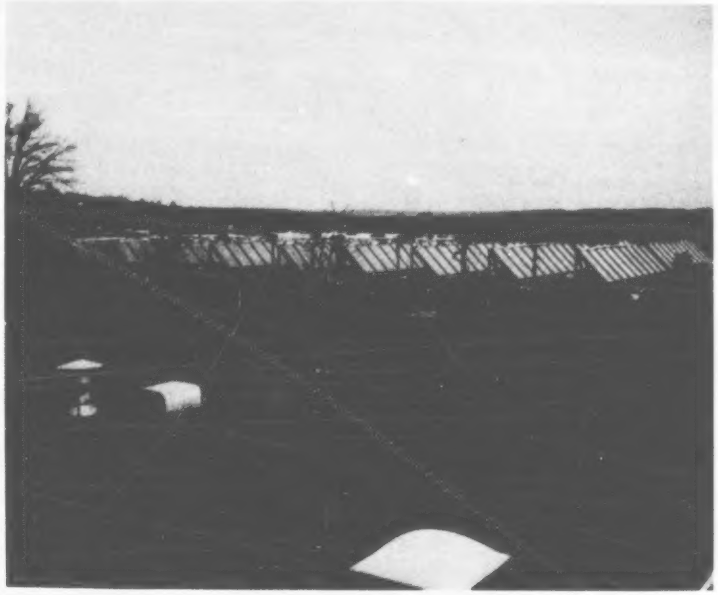
Building
  Type: Elementary school
  Area: 60,000 sq.ft.(total); 10,000(cond.)

Location: Timonium, Maryland

Latitude: 39.5°N

Climatic Data

Degree Days	Heating 4729	Cooling 1108
Avg. Temp. (°F)	Winter 45.9	Summer 73.1
Avg. Insol.(Ly/d)	Winter 288	Summer 488



SOLAR ENERGY SYSTEM

Application Heating 50% Cooling ✓ Hot Water 0%

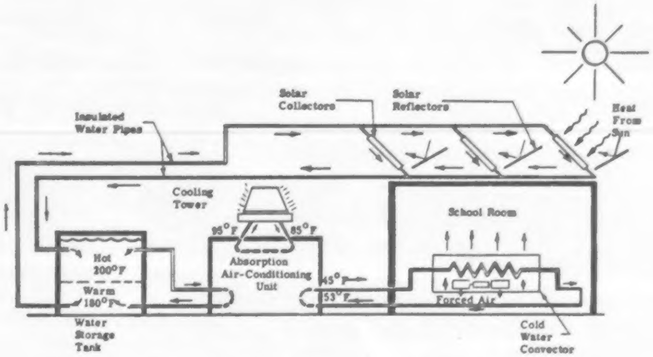
Collector
  Type: Liquid flat-plate/reflector
  Area (sq. ft.): 4,713/6,480
  Manufacturer:

Storage
  Type: Water
  Capacity: 55,000 gallons

Auxiliary System Type: Oil boiler

PROJECT DESCRIPTION

This project provided for the design, fabrication, and installation of a retrofit solar heating and cooling system for one wing of the Timonium Elementary School. Solar system operation and maintenance have begun. The system consists of liquid honeycomb construction flat-plate collectors with fixed mirrors, hot and cold storage tanks, and a 150-ton York absorption chiller. Two principal modifications were made. A cooling tower was added and a condensate drain line was run to convectors in the classrooms. This was the first school in the U.S. to have solar heating and cooling. The project also called for studies of the feasibility of installing systems similar to this in other buildings.


Insulated Water Pipes
Solar Collectors
Solar Reflectors
Heat From Sun
Cooling Tower
95°F
85°F
School Room
Hot 200°F
Warm 180°F
Absorption Air-Conditioning Unit
45°F
53°F
Forced Air
Water Storage Tank
Cold Water Convector

Schematic of Air-Conditioning System
Using Absorption Unit

PROJECT INFORMATION

Owner/Builder: City of Boston (Dorchester)

Contractor: General Electric

Operational Date: March 1974

Total Estimated ERDA Funds: $594,000

Building
Type: School
Area: 61,000 sq.ft.(total); 21,000(cond.)

Location: Boston (Dorchester), Massachusetts

Latitude: 42.4°N

Climatic Data

Degree Days	Heating 5621	Cooling 661
Avg. Temp. (°F)	Winter 42.3	Summer 70.9
Avg. Insol.(Ly/d)	Winter 248	Summer 479

SOLAR ENERGY SYSTEM

Application Heating 65% Cooling 0% Hot Water 0%

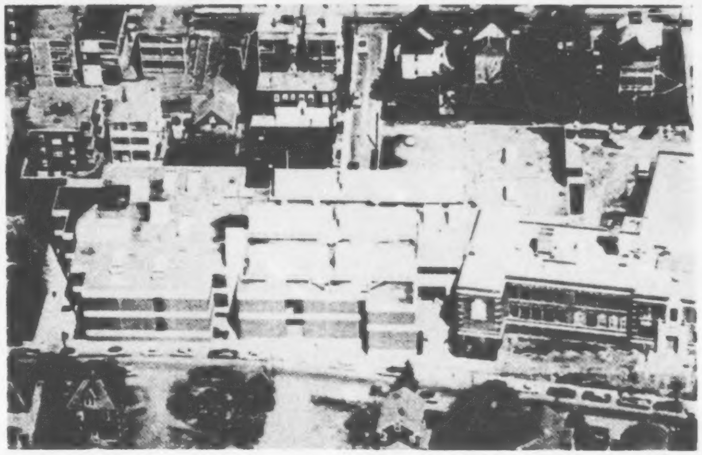
Collector
Type: Water heating aluminum rollbond flat-plate with Lexan glazings
Area (sq. ft.): 4,600
Manufacturer: General Electric Co.

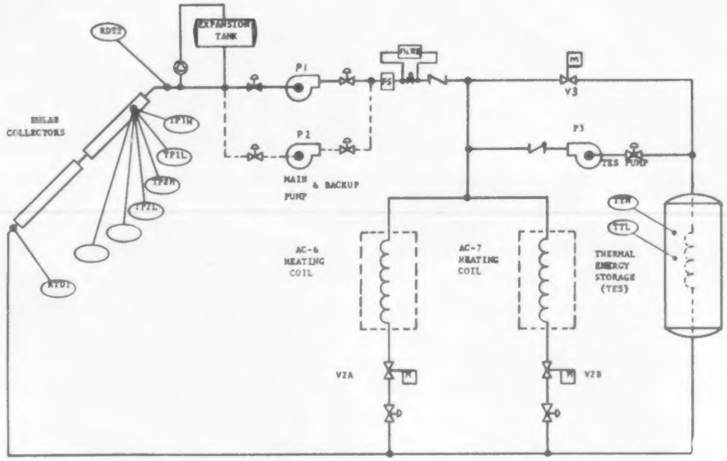
Storage
Type: Silicon base fluid SF 96-50
Capacity: 2,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

For this project, a large experimental solar array was designed, constructed and operated for the Grover Cleveland School in a heavily populated area of Boston, Mass. One of the project goals was demonstrating the feasibility of the use of solar heating systems in the northeastern U.S. Another objective was simply the obtaining of qualitative and quantitative operational data. The roof-mounted collectors used in this project provide only a portion of the building with heat.




RDT2
EXPANSION TANK
P1
FLOW
FS
M
V3
SOLAR COLLECTORS
TP1H
TP1L
TP2H
TP2L
RTD1
P2
MAIN & BACKUP PUMP
P3
TES PUMP
TTH
TTL
AC-6 HEATING COIL
AC-7 HEATING COIL
THERMAL ENERGY STORAGE (TES)
V2A
M
V2B

PROJECT INFORMATION

Owner/Builder: Ingham County Board of Commissioners
Contractor: Manyam and Associates
Operational Date: November 1978
Total Estimated ERDA Funds: $336,700
Building
  Type: Health center/hospital
  Area:
Location: Ingham County, Michigan
Latitude: 42.7°N
Climatic Data

Degree Days	Heating	6904	Cooling	535
Avg. Temp. (°F)	Winter	40.2	Summer	69.2
Avg. Insol.(Ly/d)	Winter	267	Summer	526

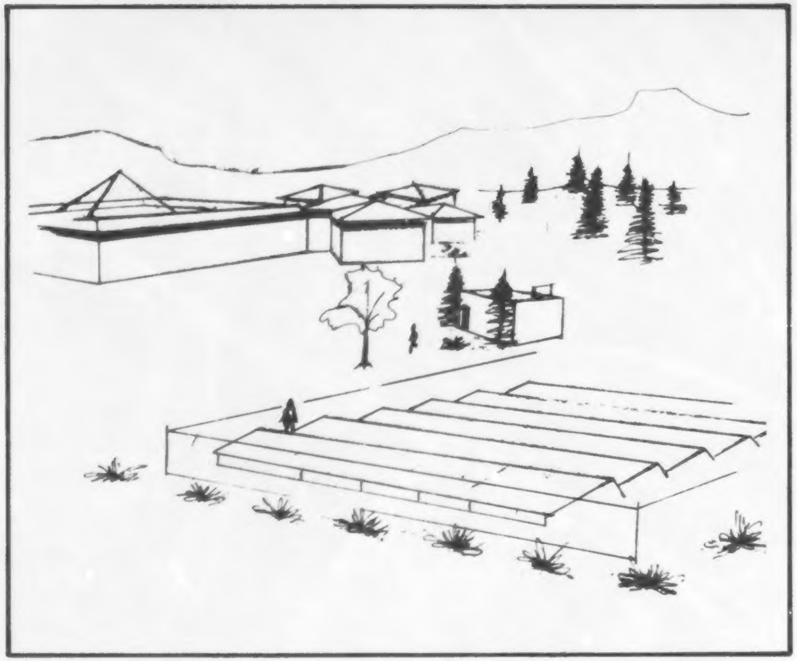
SOLAR ENERGY SYSTEM

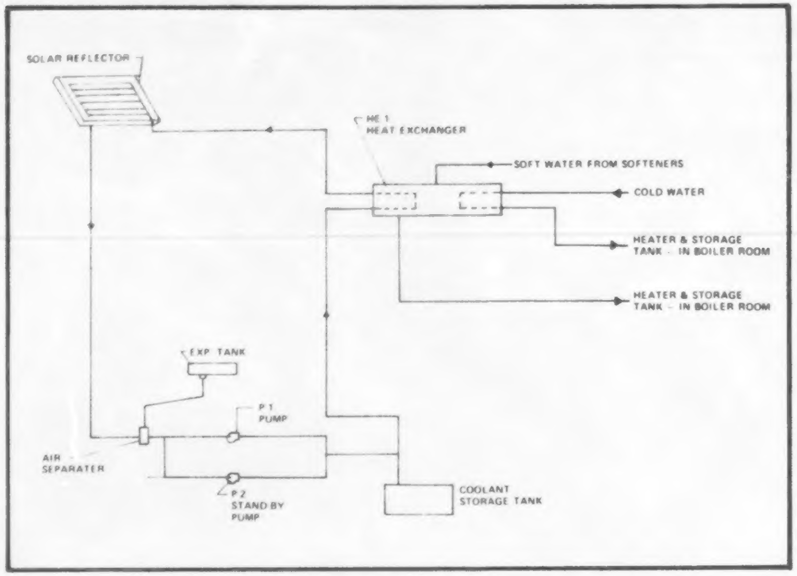
Application Heating 0% Cooling 0% Hot Water ✓
Collector
  Type: Flat-plate
  Area (sq. ft.): 10,000
  Manufacturer: Revere
Storage
  Type: Water
  Capacity: 5,000 gallons
Auxiliary System Type: Oil

PROJECT DESCRIPTION

The solar energy water heating system will help to meet the hot water demands of a 204 bed hospital and geriatric facility. The water heating system will be supplemented by systems for solid waste combustion and thermal energy recycling. Since much of the demand for hot water occurs during daylight hours, the storage facility requirement will be minimized, the preheated water being used almost immediately. A conventional oil heating system will be used to raise the temperature of the preheated water to its required level, between 140°F and 180°F. The use of the solar energy system should result in an annual reduction of 25% in fuel oil cost. The successful operation of such system is especially important for relatively energy poor states such as Michigan, which currently depend almost entirely on out of state sources for their fuel and energy supply.

74




SOLAR REFLECTOR
HE 1
HEAT EXCHANGER
SOFT WATER FROM SOFTENERS
COLD WATER
HEATER & STORAGE TANK - IN BOILER ROOM
HEATER & STORAGE TANK - IN BOILER ROOM
EXP TANK
P 1 PUMP
AIR SEPARATER
P 2 STAND BY PUMP
COOLANT STORAGE TANK

75

PROJECT INFORMATION

Owner/Builder: Telex Communications, Inc.

Contractor: Inter Technology Corporation

Operational Date: January 1977

Total Estimated ERDA Funds: $350,000

Building
Type: Manufacturing plant
Area: 97,000 sq.ft.

Location: Blue Earth, Minesota

Latitude: 44.9°N(Minneapolis)

Climatic Data

Degree Days	Heating 8154	Cooling 585
Avg. Temp. (°F)	Winter 35.6	Summer 69.7
Avg. Insol.(Ly/d)	Winter 269	Summer 516.

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%

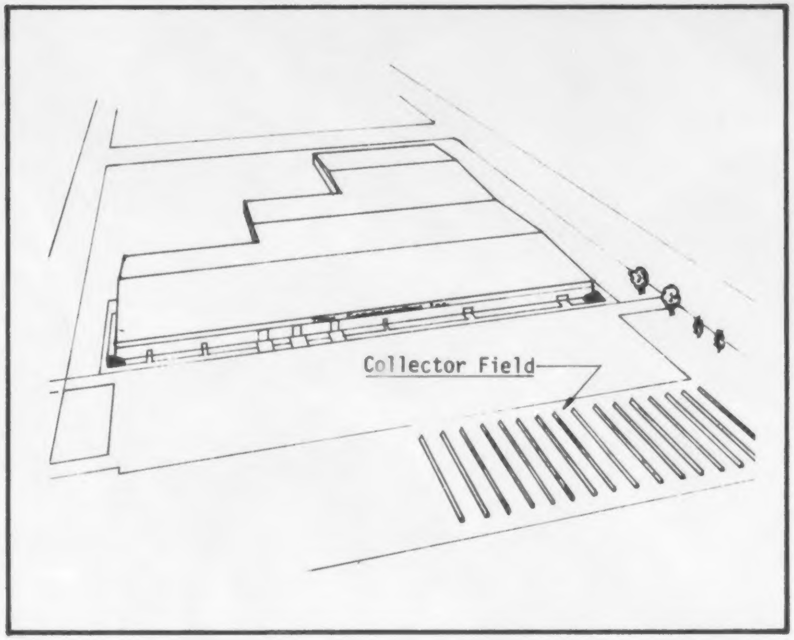
Collector
Type: Flat-plate
Area (sq. ft.): 20,000
Manufacturer: Solar Corp. of America

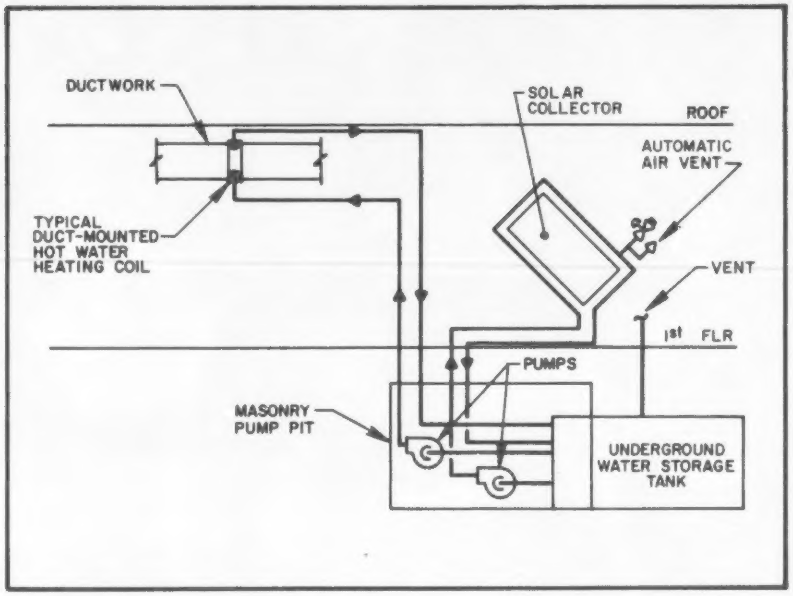
Storage
Type: Water
Capacity: 40,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The solar energy system to be installed will rely on ground-mounted solar collectors adjacent to the building and on a storage tank buried beneath the collectors. The tank will be deep enough to be below the frost line. Heat gathered at the collectors will be stored in the tank. Stored heat will then be relayed to hot water heating coils that will provide heat for the building. The building has two sources of "free heat" that will also be used, a soldering machine and an air compressor. This equipment is operated daily in the assembly plant, but it has not previously been used as an energy source. A nearby vocational school that does technical training and computer work for the Telex plant is interested in offering cources on solar energy systems, and the equipment installed in the Telex plant could be used for that purpose.


Collector Field


DUCTWORK
SOLAR COLLECTOR
ROOF
AUTOMATIC AIR VENT
TYPICAL DUCT-MOUNTED HOT WATER HEATING COIL
VENT
1st FLR
PUMPS
MASONRY PUMP PIT
UNDERGROUND WATER STORAGE TANK

PROJECT INFORMATION

Owner/Builder: University of Minnesota

Contractor: Depts. of Mech. Eng., Civil & Mineral Eng.
University of Minnesota

Operational Date: November 1977

Total Estimated ERDA Funds: $92,000 (design)

Building
Type: Bookstore
Area: 83,000 sq.ft.

Location: Minneapolis, Minnesota

Latitude: 44.9°N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	269
Avg. Insol.(Ly/d)	Winter	69.7	Summer	516

SOLAR ENERGY SYSTEM

Application Heating 75% Cooling ✓ Hot Water ✓

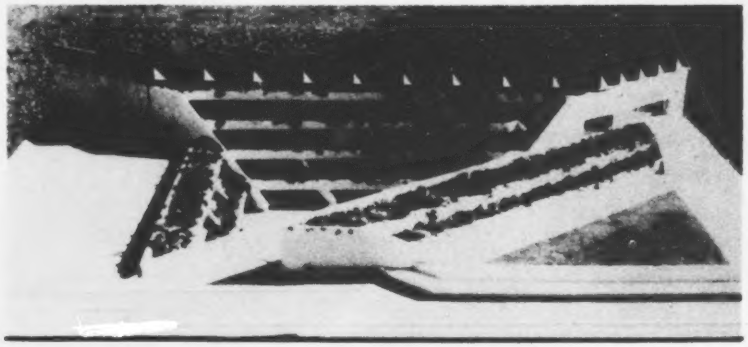
Collector
Type: Flat-plate
Area (sq. ft.): 4,000
Manufacturer: AMETEK, Inc.

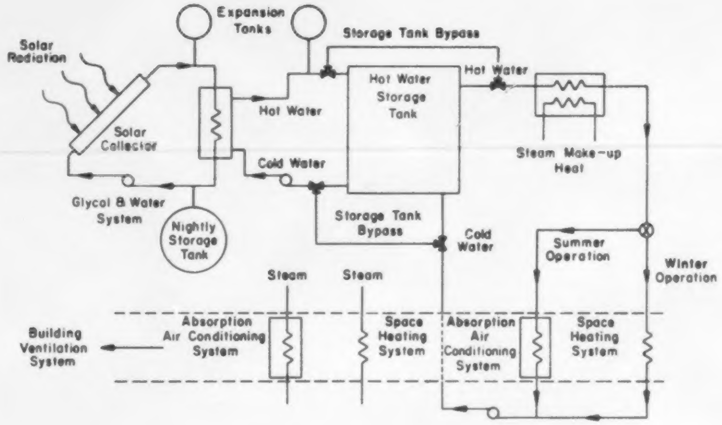
Storage
Type: Glycol water solution
Capacity: 100 gallons

Auxiliary System Type: District steam system

PROJECT DESCRIPTION

A solar assisted heating and cooling system will be designed and installed in a large building presently being constructed on the Minneapolis campus of the University of Minnesota. The building, which will house a bookstore and records and admissions offices, is being built 95% below ground. The underground construction should provide energy savings of between 60 and 70%, the exact figure depending on the thermal characteristics of the surrounding rock and soil. The building will fit effectively into its surroundings and disrupt as little as possible the space occupied. Two solar energy systems are currently being considered for use in the building, one using a flat-plate collector and one using a concentrating collector. The decision as to which type of collector to use will be made when performance testing of the two collectors is completed.




Expansion Tanks
Storage Tank Bypass
Solar Radiation
Hot Water Storage Tank
Hot Water
Solar Collector
Hot Water
Cold Water
Steam Make-up Heat
Glycol & Water System
Nightly Storage Tank
Storage Tank Bypass
Cold Water
Summer Operation
Winter Operation
Steam
Steam
Building Ventilation System
Absorption Air Conditioning System
Space Heating System
Absorption Air Conditioning System
Space Heating System

PROJECT INFORMATION

Owner/Builder: Osseo School District

Contractor: Honeywell, Inc.

Operational Date: April 1974

Total Estimated ERDA Funds: $509,633

Building
  Type: School
  Area: 165,583 sq.ft.(total), one room cond.

Location: Brooklyn Center, Minnesota

Latitude: 45.1°N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	69.7
Avg. Insol.(Ly/d)	Winter	269	Summer	516

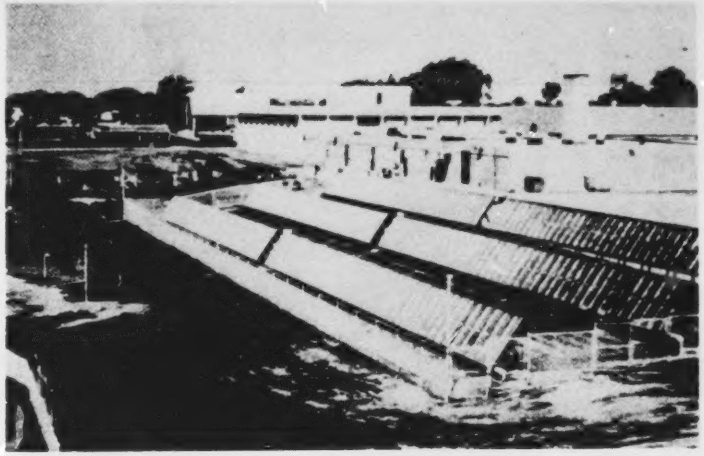
SOLAR ENERGY SYSTEM

Application Heating 54% Cooling 0% Hot Water 21%

Collector
  Type: Liquid cooled flat-plate
  Area (sq. ft.): 5,000
  Manufacturer: Honeywell, Inc.

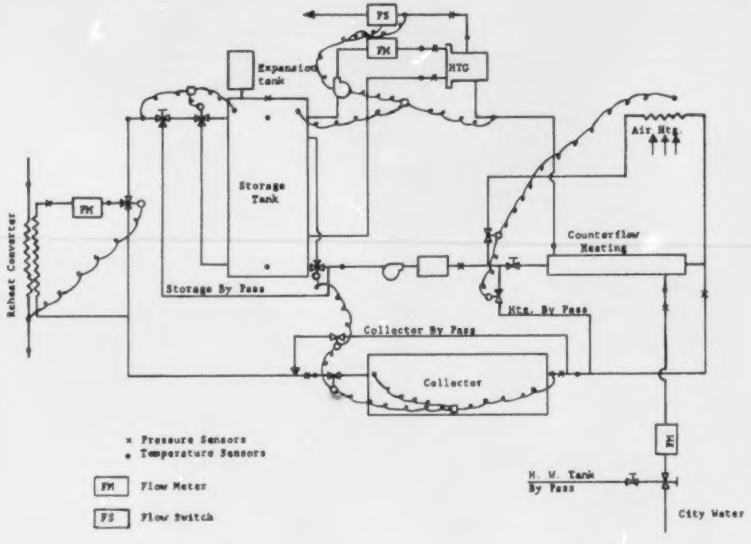
Storage
  Type: Ethylene glycol water solution
  Capacity: 3,000 gallons

Auxiliary System Type: Gas fired boiler



PROJECT DESCRIPTION

This project provides for the design, installation, and testing of a solar energy system for the North View Junior High School. The system will meet a part of the space and hot water heating requirements of the school's indoor swimming pool. During the first year of system operation, the performance of the system has been evaluated, and a heat exchanger has been installed in the swimming pool's re-circulation system. The Tedlar film on one sixth of the collectors will be replaced with a second anti-reflective cover glass, and collector performance has been reevaluated. Besides reducing energy consumption, this system should provide useful data on solar collector and system performance. The data can be used in designing similar systems for other schools and in future research and development work.


FS
FM
Expansion tank
HTG
Storage Tank
Air Htg.
Reheat Converter
FM
Counterflow Heating
Storage By Pass
Htg. By Pass
Collector By Pass
Collector
x Pressure Sensors
• Temperature Sensors
FM Flow Meter
FS Flow Switch
FM
H. W. Tank By Pass
City Water

PROJECT INFORMATION

Owner/Builder: Radisson Hotel Corp.

Contractor:

Operational Date: September 1978

Total Estimated ERDA Funds: $360,000

Building

Type: Convention hotel

Area: 200,000 sq.ft.

Location: St. Paul, Minnesota

Latitude: 44.9°N

Climatic Data

Degree Days	Heating	8159	Cooling	585
Avg. Temp. (°F)	Winter	35.6	Summer	69.7
Avg. Insol.(Ly/d)	Winter	269	Summer	516

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

Collector

Type: Hydronic flat-plate/air cooled flat-plate

Area (sq. ft.): 4,752/3,744

Manufacturer: Lennox Industries-Honeywell Inc.

Storage

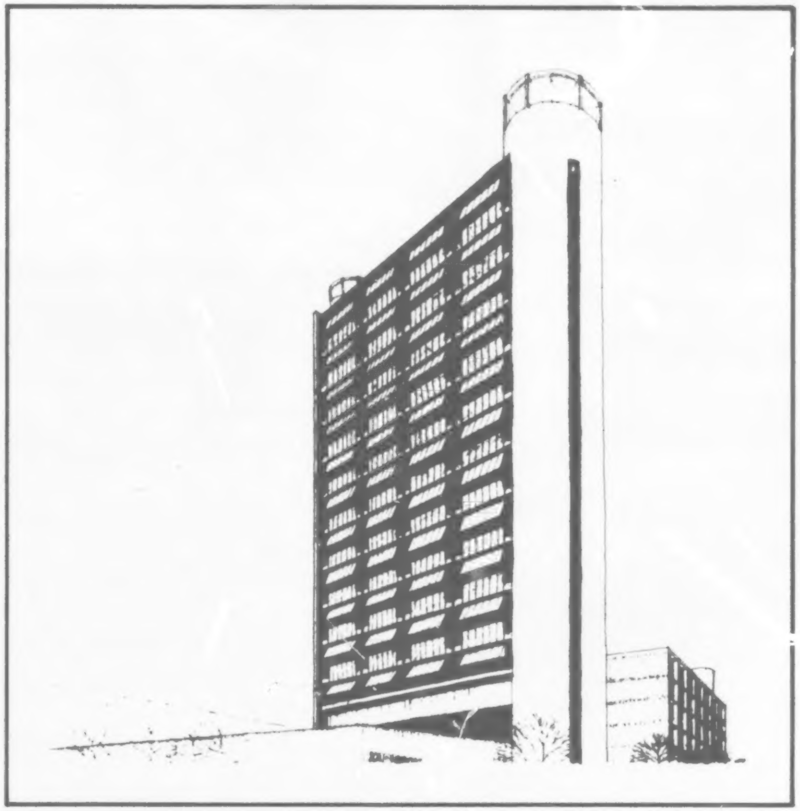
Type: Ethylene glycol and water

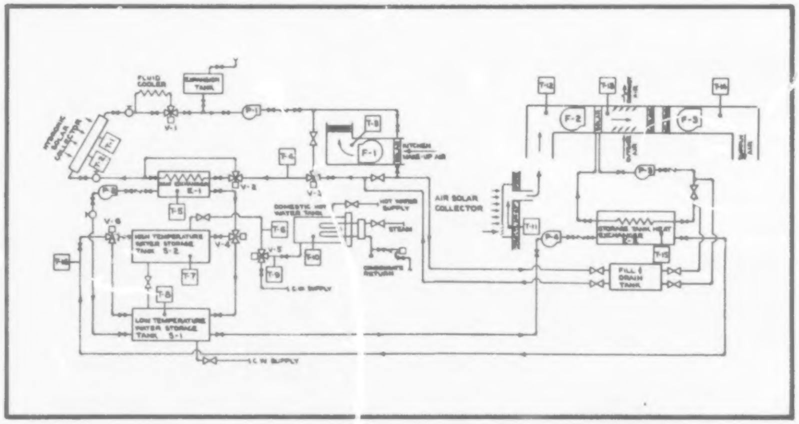
Capacity: 8,000 gallons

Auxiliary System Type: Steam

PROJECT DESCRIPTION

A 250 room high-rise hotel with convention facilities will be constructed in a downtown location. The collector panels of two solar systems are integrated into the exterior building wall and roof system. Hydronic flat-plate collectors tilted at 51 degrees will provide hot water heating. Vertically mounted air-cooled flat-plate collectors will provide ventilation air heating. Two 4,000-gal. storage tanks are located on the ground floor. Hot air from the air panels is interjected directly into guest room ventilation or used to heat water in the storage tanks. A central municipal steam plant will provide high-pressure steam to the site when auxiliary energy is needed.




HYDRONIC SOLAR COLLECTOR
FLUID COOLER
EXPANSION TANK
V-1
P-1
T-1
T-2
T-3
F-1
KITCHEN MAKE-UP AIR
T-4
E-1
V-2
V-3
P-2
T-5
DOMESTIC HOT WATER TANK
HOT WATER SUPPLY
STEAM
CONDENSATE RETURN
V-6
HIGH TEMPERATURE WATER STORAGE TANK S-2
V-4
T-6
V-5
T-10
T-9
C.W. SUPPLY
T-7
T-8
LOW TEMPERATURE WATER STORAGE TANK S-1
C.W. SUPPLY
AIR SOLAR COLLECTOR
T-11
T-12
T-13
T-14
F-2
F-3
OUTSIDE AIR
P-3
P-4
STORAGE TANK HEAT EXCHANGER
T-15
FILL & DRAIN TANK

PROJECT INFORMATION

Owner/Builder: City of Kansas City

Contractor:

Operational Date: May 1978

Total Estimated ERDA Funds: $131,829

Building
- Type: Two-bay fire station
- Area: 6,000 sq.ft.

Location: Kansas City, Missouri

Latitude: 39.3°N

Climatic Data

Degree Days	Heating 5161	Cooling 1421
Avg. Temp. (°F)	Winter 41.7	Summer 72.8
Avg. Insol.(Ly/d)	Winter 266	Summer 528

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%

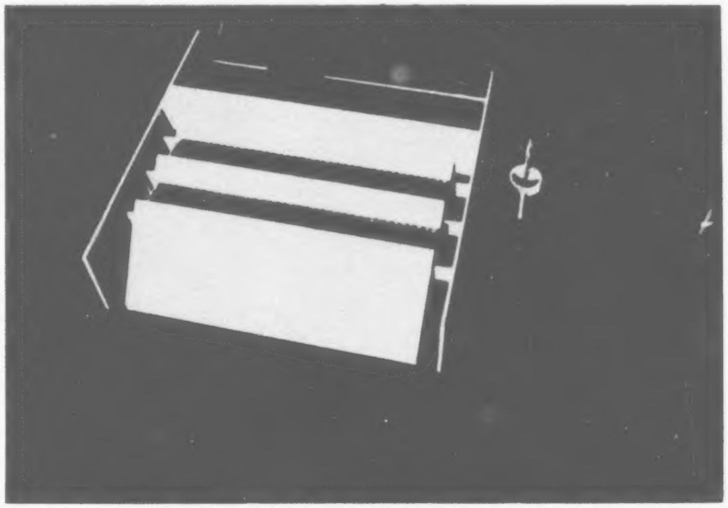
Collector
- Type: Air heating flat-plate
- Area (sq. ft.): 2,808
- Manufacturer: Solaron Corporation

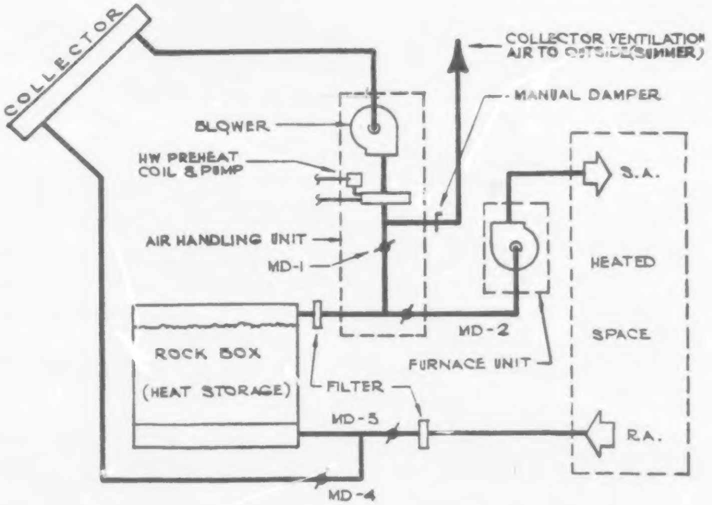
Storage
- Type: Washed river rock
- Capacity: 1,400 cu.ft.

Auxiliary System Type: Electric furnaces

PROJECT DESCRIPTION

The fire station which has two apparatus bays and living quarters for fourteen firemen, is located on a 3.5 acre semi-rural site in southeast Kansas City. The total project, with the exception of the solar provisions, is currently funded through Kansas City Fire Protection Bonds. The factory-assembled solar collectors are located on the roof and are oriented 15 degrees west of true south. Heat loss is reduced by the addition of extra insulation and by utilizing insulating glass. A concrete box insulated and filled with 50 pounds of rock per square foot of collector area serves as the storage medium for solar heat. Solar heated air is routed through the storage unit, thereby heating the rocks and returns to the collector for reheating.




COLLECTOR
COLLECTOR VENTILATION AIR TO OUTSIDE(SUMMER)
MANUAL DAMPER
BLOWER
HW PREHEAT COIL & PUMP
AIR HANDLING UNIT
MD-1
S.A.
HEATED SPACE
MD-2
ROCK BOX (HEAT STORAGE)
FURNACE UNIT
FILTER
MD-3
R.A.
MD-4

PROJECT INFORMATION

Owner/Builder: Kalwall Corporation

Contractor:

Operational Date: September 1976

Total Estimated ERDA Funds: $28,600

Building
  Type: Warehouse
  Area: 8,640 sq.ft.

Location: Manchester, New Hampshire

Latitude: 43.0°N

Climatic Data

Degree Days	Heating 7360	Cooling 349
Avg. Temp. (°F)	Winter 38.5	Summer 68.5
Avg. Insol.(Ly/d)	Winter 266	Summer 488

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%

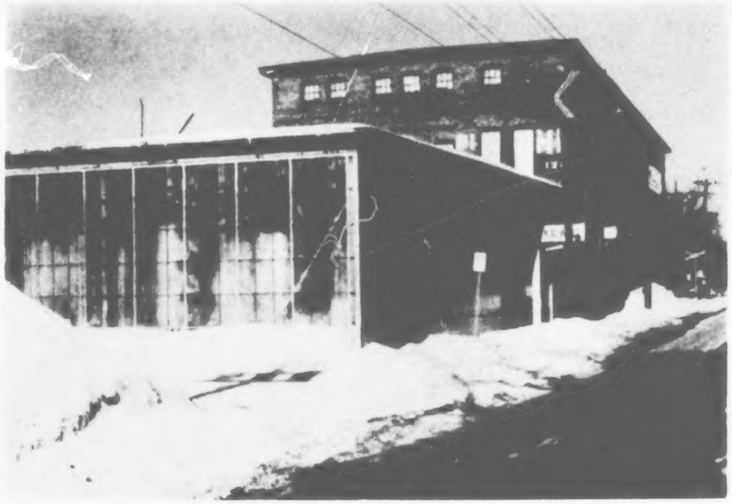
Collector
  Type: Vertical wall panels (passive system)
  Area (sq. ft.): 1700
  Manufacturer: Kalwall Corporation

Storage
  Type: Concrete floor
  Capacity:

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

Approximately 90% of the south-facing wall of a wood post and beam construction commercial warehouse has been retrofitted with an insulated solar window panel system which permits maximum insolation, yet is highly insulated to reduce heat losses. The concrete floors and exposed surfaces of adjacent fixtures inside the warehouse have been painted black. The inside area acts as part of the collector, trapping both heat radiation and convection. This area could have an overall absorption factor of 98 or 99% even though the same paint used in a flat-plate collector might have an inherent absorption coefficient of only 95%. The warehouse currently houses a retail building materials center. A 5000-sq.ft. area has been partitioned off for retail sales, and this area will continue to be heated by the existing hot water boiler.



Solar system sketch not applicable

PROJECT INFORMATION

Owner/Builder: Somerset County Park Commission

Contractor: Somerset County Park Commission

Operational Date: October 1976

Total Estimated ERDA Funds: $560,000

Building
- Type: Auditorium/classroom
- Area: 16,000 sq.ft.(total); 13,000 sq.ft.(heat); 9,000 sq.ft.(cool)

Location: Basking Ridge, New Jersey

Latitude: 40.8°N

Climatic Data

Degree Days	Heating 4897	Cooling 1021
Avg. Temp. (°F)	Winter 51.6	Summer 72.5
Avg. Insol.(Ly/d)	Winter 300	Summer 466

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 60% Hot Water ✓

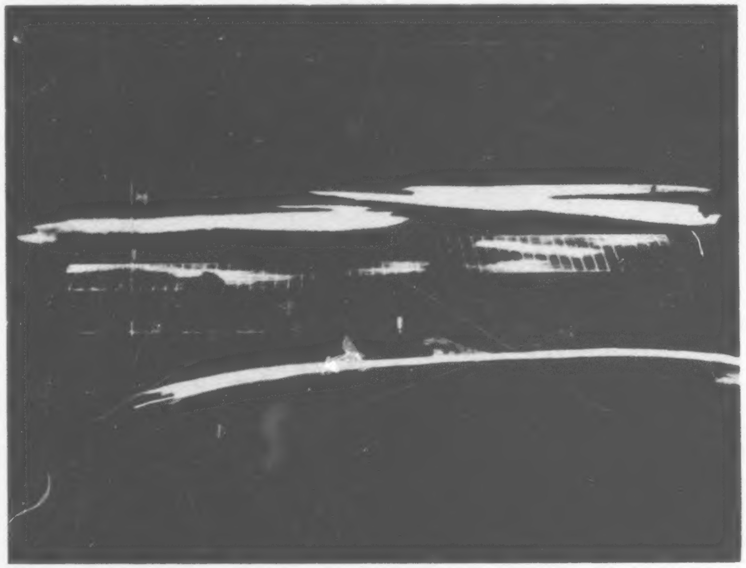
Collector
- Type: Single glazed flat-plate
- Area (sq. ft.): 3,100
- Manufacturer: General Electric Co.

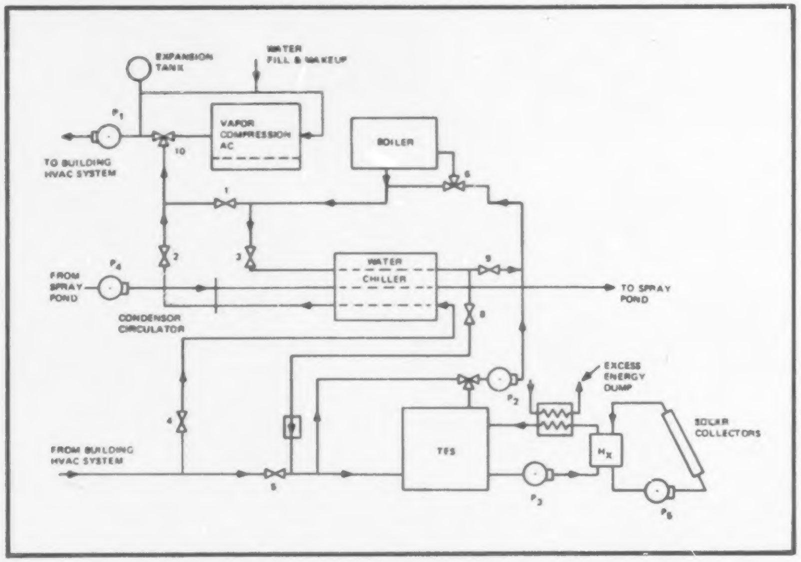
Storage
- Type: Water
- Capacity: 6,000 gallons

Auxiliary System Type: Oil fired boiler, electric

PROJECT DESCRIPTION

This project incorporates "an aesthetically and environmentally pleasing" solar system into an Environmental Education Center now under construction. Glazed collectors are integrated into a shallow pitch roof. A second glazing is provided by the roof itself. They provide energy to heat the building directly and cool it through an absorption air conditioner. Hot water is stored in underground tanks to provide storage and retrieval capability for excess energy. A pond acts as a cooling sink for the 25-ton absorption air conditioner instead of a standard cooling tower. The system is fully instrumented to evaluate performance. An instrumentation console provides for data display and recording and a display panel graphically illustrates system operation. This equipment is part of an overall energy conservation display available to visitors to the Environmental Center as part of its educational program.




EXPANSION TANK
WATER FILL & MAKEUP
P1
VAPOR COMPRESSION AC
10
BOILER
TO BUILDING HVAC SYSTEM
6
1
2
3
WATER CHILLER
9
FROM SPRAY POND
P4
TO SPRAY POND
CONDENSOR CIRCULATOR
8
EXCESS ENERGY DUMP
P2
4
SOLAR COLLECTORS
TES
Hx
FROM BUILDING HVAC SYSTEM
5
P3
P5

PROJECT INFORMATION

Owner/Builder: RKL Controls, Inc.

Contractor:

Operational Date: August 1977

Total Estimated ERDA Funds: $566,293

Building

Type: Control valve manufacturing

Area: 40,000 sq.ft.

Location: Lumberton, New Jersey

Latitude: 40.0°(Burlington Co.)

Climatic Data

Degree Days	Heating 4865	Cooling 1104
Avg. Temp. (°F)	Winter 45.4	Summer 73.0
Avg. Insol.(Ly/d)	Winter 290	Summer 486

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water ✓

Collector

Type: Double glazed liquid flat-plate

Area (sq. ft.): 6,000

Manufacturer: Sunworks, Inc.

Storage

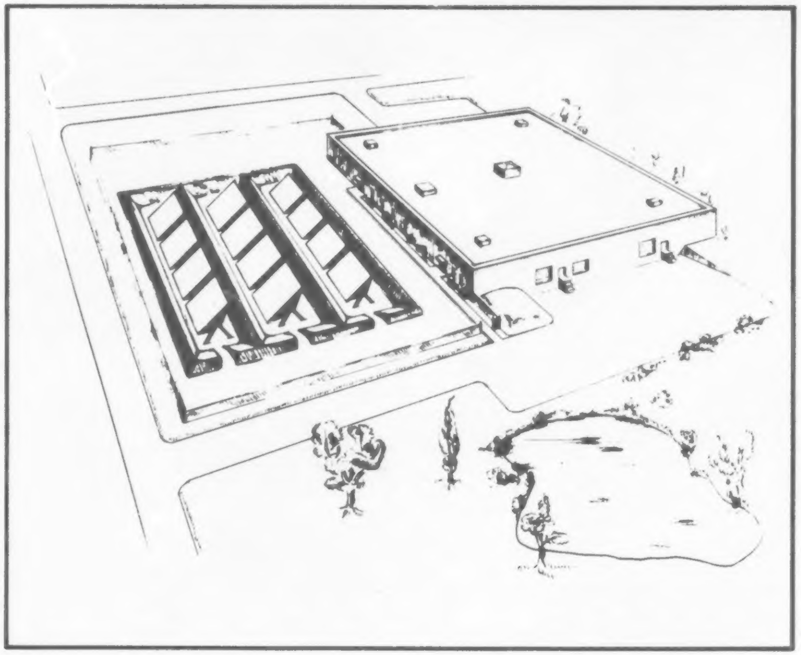
Type: Water

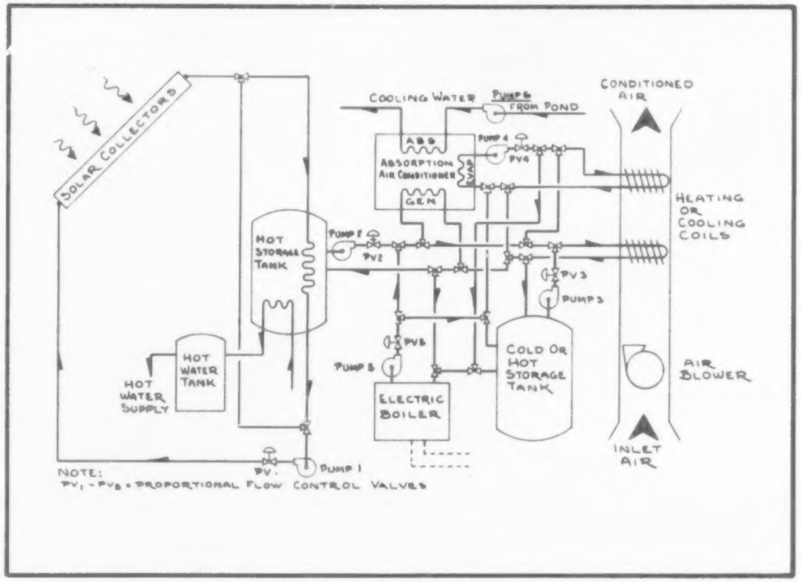
Capacity: 50,000 gallons

Auxiliary System Type: Electric boiler

PROJECT DESCRIPTION

The building is a conventional one-story, cinderblock, steel post, bar joist, metal deck construction to be used for light industrial manufacturing. Heat loss is reduced by external insulation, the use of air locks on all entrances, and the use of energy recovery systems. The flat-plate, double glazed, liquid collectors are arranged between earthen berms on three separate seasonably trackable arrays adjacent to the manufacturing building. A nearby man made pond serves as a catch basin for rain runoff and as a cooling facility to supply the basin chiller with low temperature condensing water.




SOLAR COLLECTORS
COOLING WATER
PUMP 6
FROM POND
CONDITIONED AIR
ABS
ABSORPTION AIR CONDITIONER
EVAP
GEN
PUMP 4
PV4
HEATING OR COOLING COILS
HOT STORAGE TANK
PUMP 2
PV2
PV3
PUMP 3
PV5
PUMP 5
HOT WATER TANK
HOT WATER SUPPLY
ELECTRIC BOILER
COLD OR HOT STORAGE TANK
AIR BLOWER
INLET AIR
PV1
PUMP 1
NOTE:
PV1 - PV5 = PROPORTIONAL FLOW CONTROL VALVES

PROJECT INFORMATION

Owner/Builder: New Mexico State University

Contractor: New Mexico State University

Operational Date: September 1975

Total Estimated ERDA Funds: $136,000 (instrumentation)

Building
    Type: Office/laboratory
    Area: 25,535 sq.ft.

Location: Las Cruces, New Mexico

Latitude: 32.3°N

Climatic Data

Degree Days	Heating	2952	Cooling	1965
Avg. Temp. (°F)	Winter	51.6	Summer	77.1
Avg. Insol.(Ly/d)	Winter	438	Summer	663

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 80% Hot Water 0%

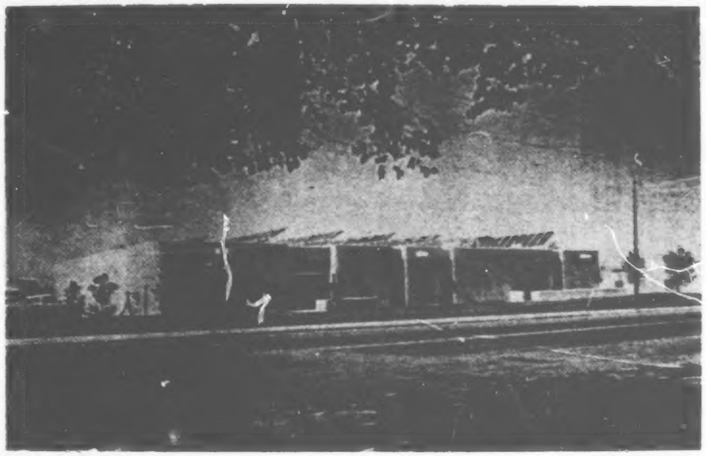
Collector
    Type: Flat-plate/concentrator
    Area (sq. ft.): 6,190/540
    Manufacturer: Miromit/Northrup Inc.

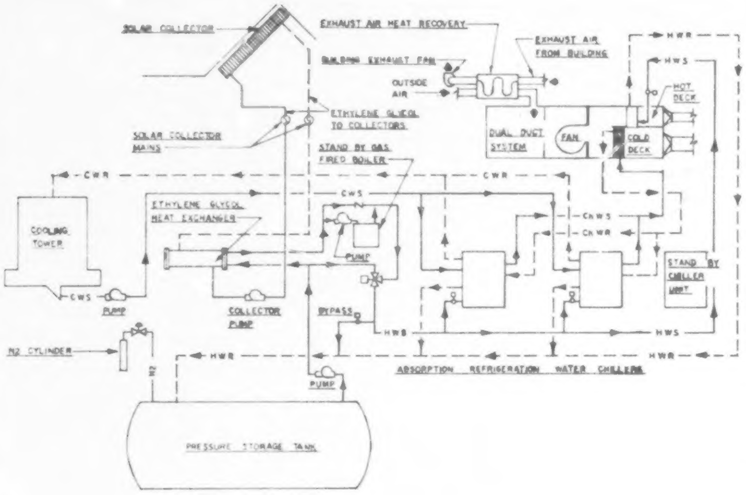
Storage
    Type: Ethelene glycol water solution
    Capacity: 30,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

The performance of an existing building's solar heating and cooling system will be evaluated. An automated data acquisition system has been designed and is being acquired along with the development of detailed simulation programs for this facility. Analysis includes evaluation of flow sensors installed in the system, performance testing of the prototype multiplexer/analog to digital conversion equipment and pyranometer comparison testing. The building project and its solar system design were funded by the legislature of the State of New Mexico. The building was occupied on October 15, 1975. The solar system utilizes a 100-ton York absorption chiller, a 25-ton ARKLA absorption chiller, and roof collectors which are 10:1 concentrators with Fresnal lens covers and selective absorber surfaces.




SOLAR COLLECTOR
EXHAUST AIR HEAT RECOVERY
EXHAUST AIR FROM BUILDING
BUILDING EXHAUST FAN
OUTSIDE AIR
HWR
HWS
HOT DECK
ETHYLENE GLYCOL TO COLLECTORS
DUAL DUCT SYSTEM
FAN
COLD DECK
SOLAR COLLECTOR MAINS
STAND BY GAS FIRED BOILER
CWR
CWS
COOLING TOWER
ETHYLENE GLYCOL HEAT EXCHANGER
PUMP
ChWS
ChWR
STAND BY CHILLER UNIT
CWS
PUMP
COLLECTOR PUMP
BYPASS
HWS
N2 CYLINDER
N2
HWR
PUMP
ABSORPTION REFRIGERATION WATER CHILLERS
PRESSURE STORAGE TANK

PROJECT INFORMATION

Owner/Builder: Nambe Indian Pueblo

Contractor: Los Alamos Scientific Laboratory

Operational Date: December 1976

Total Estimated ERDA Funds: $113,000

Building
  Type: Community center
  Area: 3,000 sq.ft.

Location: Nambe, New Mexico

Latitude: 35.9°N

Climatic Data

Degree Days	Heating	5760	Cooling	1098
Avg. Temp. (°F)	Winter	43.7	Summer	70.3
Avg. Insol.(Ly/d)	Winter	394	Summer	645

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 60% Hot Water 60%

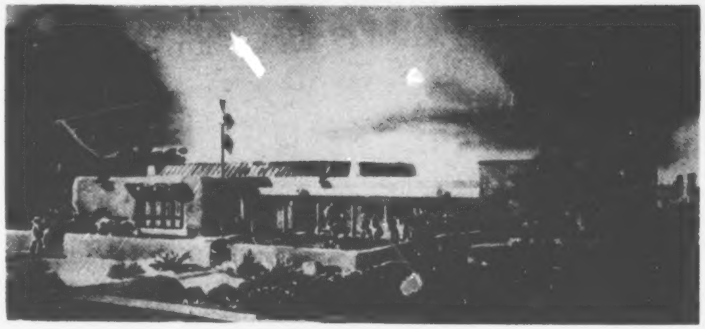
Collector
  Type: Air cooled flat-plate
  Area (sq. ft.): 1,000
  Manufacturer: LASL/ERDA

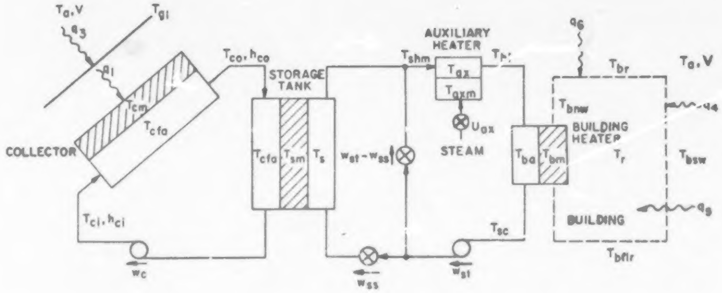
Storage
  Type: Rock
  Capacity:

Auxiliary System Type:

PROJECT DESCRIPTION

The community center building will accommodate two meeting rooms and tribal offices. The architecture will be in the Southwest Pueblo style and the construction is to be of traditional adobe. As adobe is characteristically a high mass material, the structure per se will provide considerable thermal storage. The design will incorporate appropriate passive elements and a solar assisted hot water heater. The collectors are of LASL design combining collector, insulation and water-tight roof in one structure. The building and solar system will be sufficiently instrumented to observe the hourly thermal response. The design analysis, building performance, and modeling results will be published in the technical press and presented at appropriate seminars and workshops.




T_a, V
T_{gl}
q_3
q_1
T_{cm}
T_{cfa}
COLLECTOR
T_{ci}, h_{ci}
w_c
T_{co}, h_{co}
STORAGE TANK
T_{cfa}
T_{sm}
T_s
$w_{st} - w_{ss}$
w_{ss}
T_{shm}
AUXILIARY HEATER
T_{ax}
T_{axm}
U_{ax}
STEAM
T_{hi}
T_{ba}
T_{bm}
T_{sc}
w_{st}
q_6
T_{br}
T_a, V
T_{bnw}
q_4
BUILDING HEATER
T_r
T_{bsw}
BUILDING
q_5
T_{bflr}

PROJECT INFORMATION

Owner/Builder. Charlotte Memorial Hosp. and Medical Center

Contractor: FWA Engineers, Inc.

Operational Date: November 1976

Total Estimated ERDA Funds: $204,515

Building
- Type: Health center office/classroom
- Area: 65,000 sq.ft.

Location: Charlotte, North Carolina

Latitude: 35.2°N

Climatic Data

Degree Days	Heating	3218	Cooling	1596
Avg. Temp. (°F)	Winter	50.4	Summer	74.6
Avg. Insol.(Ly/d)	Winter	318	Summer	444

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

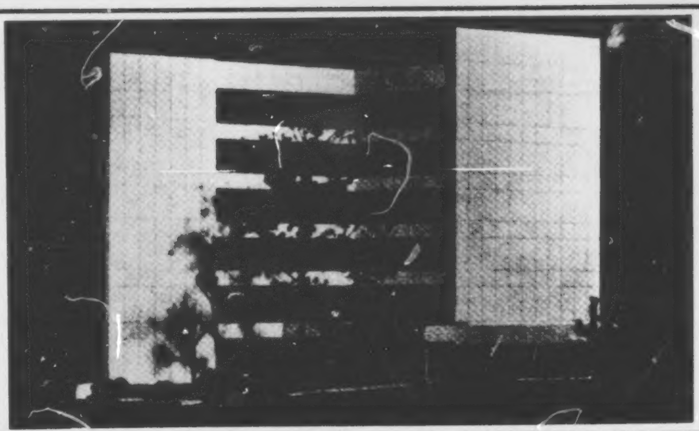
Collector
- Type: Water-cooled flat-plate
- Area (sq. ft.): 4,020
- Manufacturer: General Electric Co.

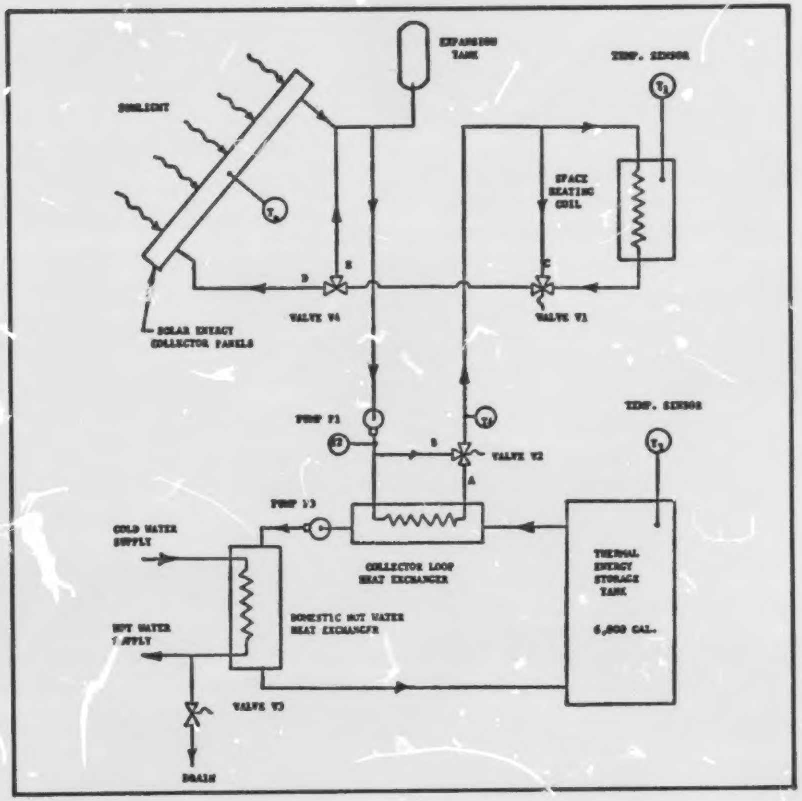
Storage
- Type: Water
- Capacity: 6,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

Solar collectors will be mounted on the roof of the Area Health and Education Facility being constructed on the grounds of Charlotte Memorial Hospital. The building is a compact, six-story high-rise structure with external shading on limited glass areas designed to reduce the heat loss and gain. The mechanical system is designed to make maximum use of the heat generated by the lights and people within the structure. The use of solar energy was not included in the original building concept. Site orientation was dictated by topography and surrounding structures. The orientation is not the best possible for the installation of a solar energy system. However, excellent insulation offered by the structure, the selection of superior solar components, and the judicious placement of solar collectors have together nullified the apparent reduction in overall solar efficiency caused by the building's orientation.




SUNLIGHT
EXPANSION TANK
TEMP. SENSOR
T_1
T_0
SPACE HEATING COIL
D
E
C
VALVE V4
VALVE V1
SOLAR ENERGY COLLECTOR PANELS
PUMP P1
T_2
T_3
B
VALVE V2
A
TEMP. SENSOR
PUMP P3
COLD WATER SUPPLY
COLLECTOR LOOP HEAT EXCHANGER
THERMAL ENERGY STORAGE TANK
6,000 GAL.
DOMESTIC HOT WATER HEAT EXCHANGER
HOT WATER SUPPLY
VALVE V3
DRAIN

PROJECT INFORMATION

Owner/Builder: Troy-Miami County Public Library

Contractor:

Operational Date: August 1977

Total Estimated ERDA Funds: $292,896

Building

Type: Library

Area: 23,200 sq.ft.

Location: Troy, Ohio

Latitude: 40.0°N

Climatic Data

Degree Days	Heating	5641	Cooling	936
Avg. Temp. (°F)	Winter	42.3	Summer	71.3
Avg. Insol.(Ly/d)	Winter	287	Summer	519

SOLAR ENERGY SYSTEM

Application Heating 76% Cooling 0% Hot Water 0%

Collector

Type: Evacuated glass tube

Area (sq. ft.): 3,617

Manufacturer: Owens-Illinois Company

Storage

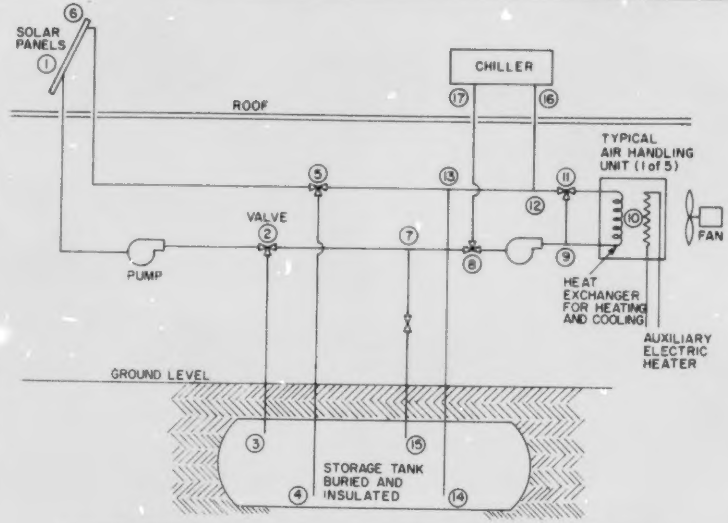
Type: Water

Capacity: 10,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This public library is located in the downtown area of the city. An array of advanced, evacuated, tubular collectors on the roof supply sufficient energy to heat the building or to drive two 25-ton, solar powered water chillers for cooling. The buried insulated storage tank will be fabricated from fiberglass to insure long-term corrosion-resistant operation. Windows have been installed in deep recesses to reduce direct heat buildup during summer months. Existing trees were trimmed to give maximum sun exposure to the collectors during the various seasons. The ratio of glass to masonry walls is less than 20 percent. The City of Troy, Ohio has expressed serious interest in becoming a model solar city. Plans are being developed to establish a program to provide financial support to design solar energy systems for every new building constructed in the city.



SOLAR PANELS
①
⑥
CHILLER
⑰
⑯
ROOF
TYPICAL AIR HANDLING UNIT (1 of 5)
⑤
⑬
⑪
⑫
VALVE
②
⑦
⑩
FAN
PUMP
⑧
⑨
HEAT EXCHANGER FOR HEATING AND COOLING
AUXILIARY ELECTRIC HEATER
GROUND LEVEL
③
⑮
STORAGE TANK BURIED AND INSULATED
④
⑭

TYPICAL HEATING AND COOLING CYCLES	FLOW PATH
SOLAR HEAT TO STORAGE	①-②-③-④-⑤-⑥-①
DIRECT SOLAR HEATING	①-②-⑦-⑧-⑨-⑩-⑪-⑫-⑬-⑤-⑥-①
HEATING FROM STORAGE	⑮-⑦-⑧-⑨-⑩-⑪-⑫-⑬-⑭-⑮
AUXILIARY HEATING	ELECTRIC RESISTANCE HEATING
CONVENTIONAL COOLING	⑰-⑧-⑨-⑩-⑪-⑫-⑯-⑰

PROJECT INFORMATION

Owner/Builder: Commonwealth of Puerto Rico

Contractor: Department of Natural Resources

Operational Date: June 1977

Total Estimated ERDA Funds: $587,000

Building
  Type: Industrial factory
  Area: 10,800 sq.ft.

Location: Canovanas, Puerto Rico

Latitude: 18.5°N

Climatic Data

Degree Days	Heating	–	Cooling	4982
Avg. Temp. (°F)	Winter	76.7	Summer	80.6
Avg. Insol.(Ly/d)	Winter	494	Summer	570

SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 95% Hot Water ✓

Collector
  Type: Evacuated tube
  Area (sq. ft.): 7,600
  Manufacturer: Owens-Illinois Company

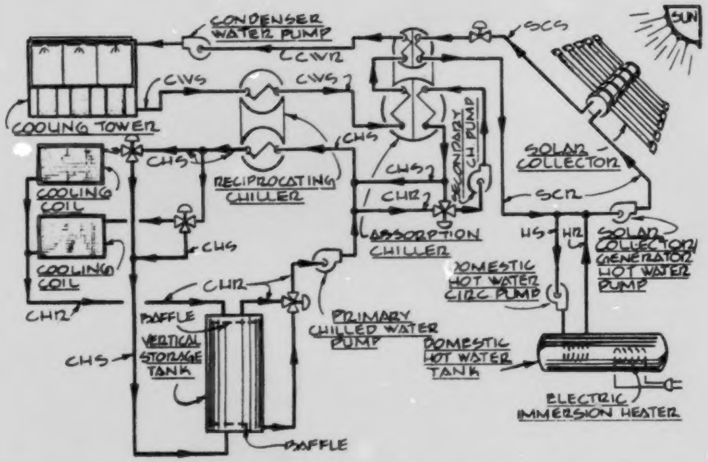
Storage
  Type: Water
  Capacity: 20,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

The Puerto Rico Industrial Development Company (Fomento), which provides standard factories and leases them at low rates to industry, has contributed this factory and its site, in Guaynabo, about six miles south of San Juan. Puerto Rico has one of the highest year-round insolations in the world. Air conditioning will be needed everyday; experimentation and data collection can be done throughout the year. Hot water is secured from the roof top solar collectors and run through an absorption refrigerating machine which generates chilled water necessary for cooling. A 30-ton electric drive reciprocating water chiller provides for auxiliary cooling. If the operation of this solar equipped building proves commercially practical and energy conservative, it would be used as a prototype for a number of buildings constructed by Fomento. It would also create the opportunity for a new solar industry to be started in Puerto Rico.

Picture not available


CONDENSER WATER PUMP
SCS
SUN
CCWR
CWS
CWS
COOLING TOWER
CHS
CHS
RECIPROCATING CHILLER
SECONDARY CH PUMP
CHS
CHR
COOLING COIL
COOLING COIL
SOLAR COLLECTOR
SCR
ABSORPTION CHILLER
HS
HR
SOLAR COLLECTOR/GENERATOR HOT WATER PUMP
DOMESTIC HOT WATER CIRC PUMP
CHS
CHR
CHR
BAFFLE
VERTICAL STORAGE TANK
CHS
PRIMARY CHILLED WATER PUMP
DOMESTIC HOT WATER TANK
ELECTRIC IMMERSION HEATER
BAFFLE

PROJECT INFORMATION

Owner/Builder: Blakedale Professional Ctr. Inc.

Contractor:

Operational Date: August 1976

Total Estimated ERDA Funds: $52,616

Building

Type: Office

Area: 4,400 sq.ft.

Location: Greenwood, South Carolina

Latitude: 34.4°N

Climatic Data

Degree Days	Heating 2926	Cooling 1789
Avg. Temp. (°F)	Winter 51.9	Summer 75.7
Avg. Insol.(Ly/d)	Winter 320	Summer: 521

SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓

Collector

Type: Water cooled flat-plate

Area (sq. ft.): 954

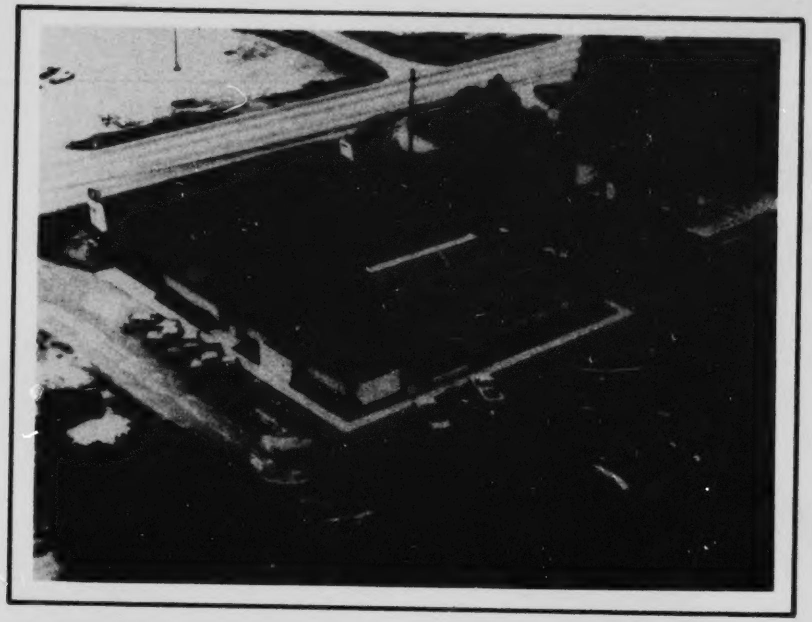
Manufacturer: Pittsburgh Plate Glass, Inc.

Storage

Type: Water

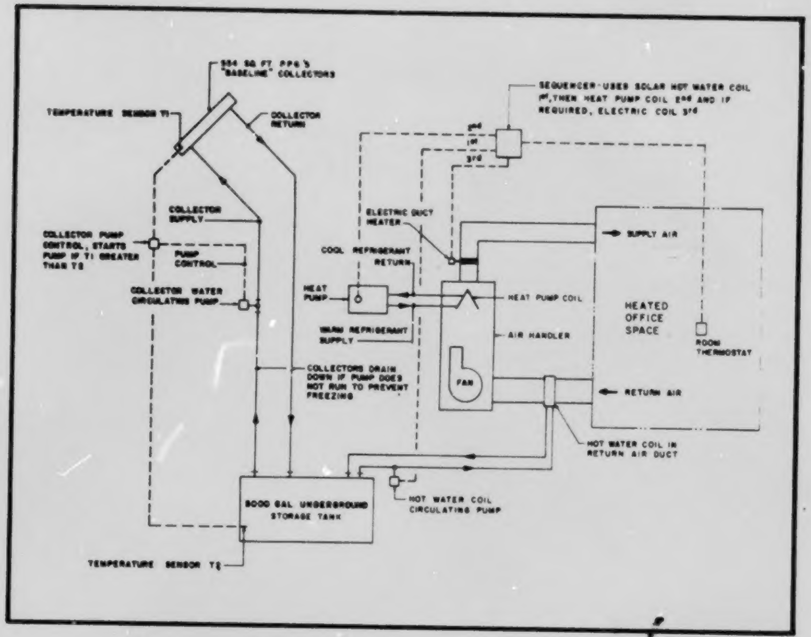
Capacity: 5,000 gallons

Auxiliary System Type: Electrical heat pump



PROJECT DESCRIPTION

This project involves the use of solar energy for space and hot water heating in an office building located in Greenwood, S.C. The solar energy system will use roof-mounted solar collectors and an underground storage rank. A conventional electric system for space and water heating will supplement the solar energy system. Heat loss in the building is minimized through the use of thermopane glass. The storage tank holds water which is circulated through the collectors whenever the water temperature is lower than the temperature of the collectors. The heated water in the storage tank is then used to preheat the city water that will be consumed in the building. Space heating is accomplished by a pump that circulates hot water from the storage tank through a coil in the air duct system. The air heated by the water in the coil is then circulated through the building.


954 SQ FT PPG'S "BASELINE" COLLECTORS
TEMPERATURE SENSOR T1
COLLECTOR RETURN
COLLECTOR SUPPLY
COLLECTOR PUMP CONTROL, STARTS PUMP IF T1 GREATER THAN T2
PUMP CONTROL
COLLECTOR WATER CIRCULATING PUMP
COLLECTORS DRAIN DOWN IF PUMP DOES NOT RUN TO PREVENT FREEZING
5000 GAL UNDERGROUND STORAGE TANK
TEMPERATURE SENSOR T2
SEQUENCER-USES SOLAR HOT WATER COIL 1st, THEN HEAT PUMP COIL 2nd AND IF REQUIRED, ELECTRIC COIL 3rd
2nd
1st
3rd
ELECTRIC DUCT HEATER
COOL REFRIGERANT RETURN
HEAT PUMP
WARM REFRIGERANT SUPPLY
HEAT PUMP COIL
AIR HANDLER
FAN
SUPPLY AIR
HEATED OFFICE SPACE
ROOM THERMOSTAT
RETURN AIR
HOT WATER COIL IN RETURN AIR DUCT
HOT WATER COIL CIRCULATING PUMP

PROJECT INFORMATION

Owner/Builder: South Dakota School of Mines

Contractor: The Spitznagel Partners

Operational Date: November 1976

Total Estimated ERDA Funds: $209,983

Building
  Type: Visitor center
  Area: 7,250 sq.ft.

Location: Keystone, South Dakota

Latitude: 43.9°N

Climatic Data

Degree Days	Heating	7292	Cooling	1488
Avg. Temp. (°F)	Winter	27.8	Summer	69.5
Avg. Insol.(Ly/d)	Winter	332	Summer	577

SOLAR ENERGY SYSTEM

Application Heating 45% Cooling 45% Hot Water 0%

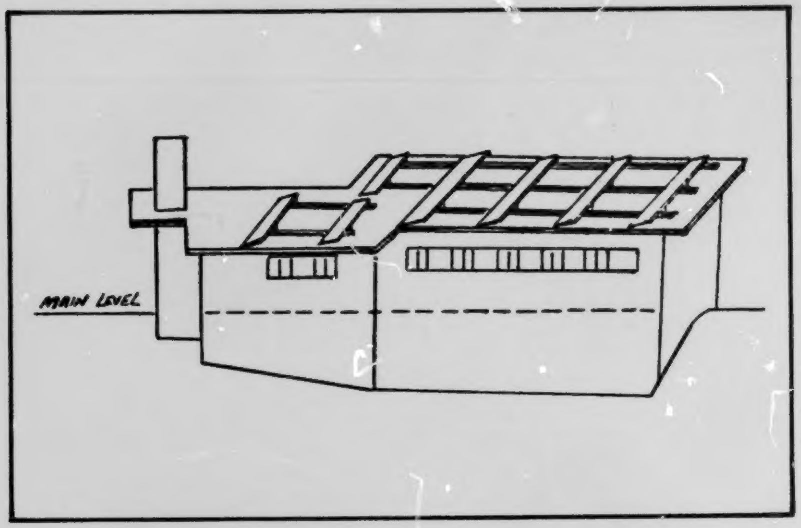
Collector
  Type: Water circulated flat-plate
  Area (sq. ft.): 2,000
  Manufacturer: Lennox Industries-Honeywell Inc.

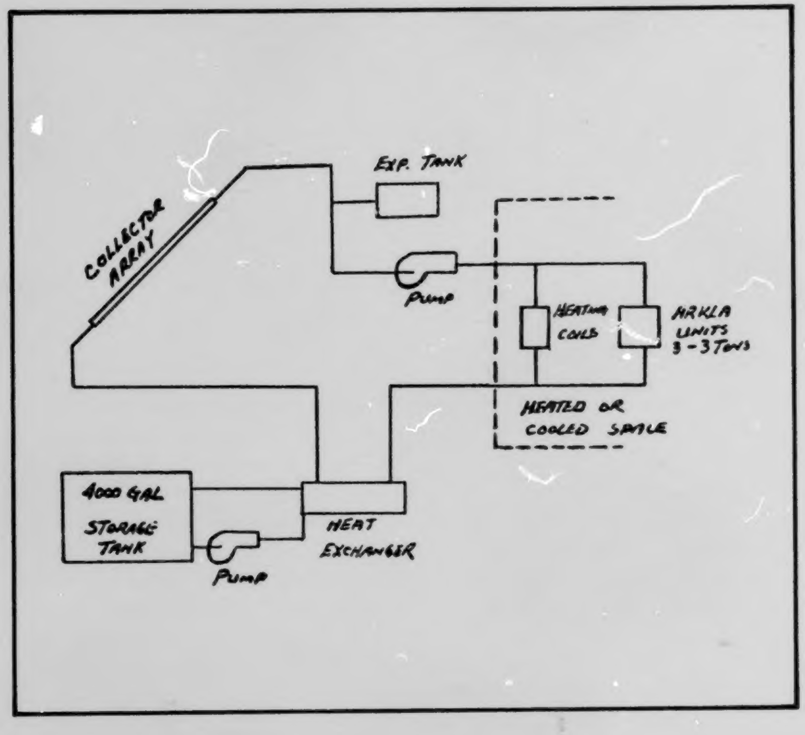
Storage
  Type: Water
  Capacity: 4,000 gallons

Auxiliary System Type: Oil furnace

PROJECT DESCRIPTION

The solar energy system will be integrated with the existing heating and cooling system of the Mount Rushmore National Visitor Center to provide approximately 45% of the total heating and approximately 45% of the cooling of the observation room. Solar collectors will be mounted on the roof facing southwest. To conserve energy, the control system will be upgraded and the make-up air will be preheated. The existing refrigeration compressor is a standard, reciprocating, Freon-22 condensing unit. The observatory room is also served by a supplementary 10-ton package unit.




EXP. TANK
COLLECTOR ARRAY
PUMP
HEATING COILS
ARKLA UNITS 3-3 TONS
HEATED OR COOLED SPACE
4000 GAL STORAGE TANK
PUMP
HEAT EXCHANGER

PROJECT INFORMATION

Owner/Builder: Radian Corporation
Contractor:
Operational Date: December 1976
Total Estimated ERDA Funds: $39,306
Building
  Type: Office/laboratory
  Area: 615 sq.ft.(conditioned)
Location: Austin, Texas
Latitude: 30.3°N
Climatic Data

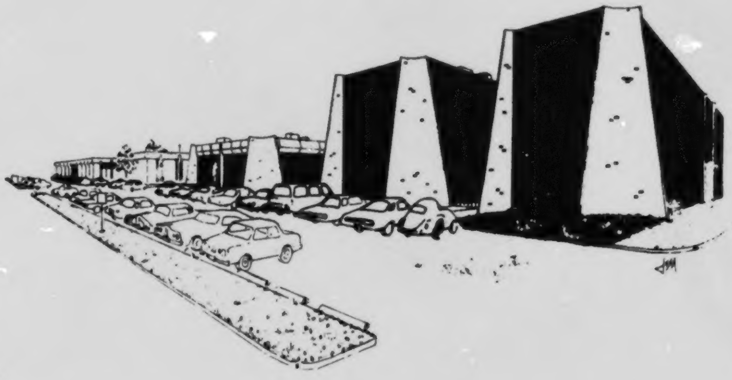
Degree Days	Heating	1737	Cooling	2908
Avg. Temp. (°F)	Winter	54.8	Summer	77.7
Avg. Insol.(Ly/d)	Winter	286	Summer	501

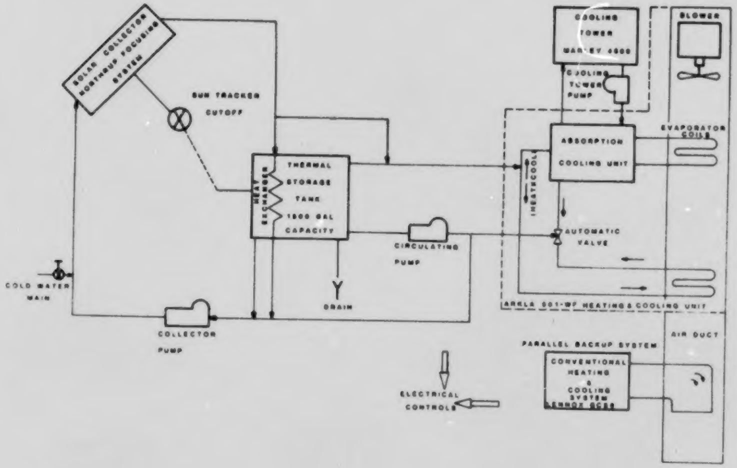
SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water 0%
Collector
  Type: Linear Fresnel Lens, concentrating & tracking
  Area (sq. ft.): 350
  Manufacturer: Northrup, Inc.
Storage
  Type: Water
  Capacity: 1,500 gallons
Auxiliary System Type: Gas fired, electric

PROJECT DESCRIPTION

This solar heating and cooling demonstration consists of heating or cooling three offices in a new office building. The three-ton solar system is set up in parallel with a three-ton conventional gas unit. The air ducts service only the three demonstration offices. This unique situation allows closely controlled performance comparisons to be made between the solar and conventional systems. Major components (an ARKLA three-ton adsorptive heating and cooling unit, the sun tracking solar collectors, and the thermal storage tank) may be easily replaced with other units for future performance evaluation purposes. In monitoring and analyzing system performance, Radian proposes to identify those areas of the system most in need of improvement. The company will then do whatever research and development work is necessary.




SOLAR COLLECTOR NORTHRUP FOCUSING SYSTEM
SUN TRACKER CUTOFF
HEAT EXCHANGER
THERMAL STORAGE TANK 1500 GAL CAPACITY
COLD WATER MAIN
COLLECTOR PUMP
DRAIN
CIRCULATING PUMP
COOLING TOWER MARLEY 4600
COOLING TOWER PUMP
BLOWER
ABSORPTION COOLING UNIT
EVAPORATOR COILS
IHEAT/COOL
AUTOMATIC VALVE
ARKLA 501-WF HEATING & COOLING UNIT
AIR DUCT
PARALLEL BACKUP SYSTEM
CONVENTIONAL HEATING & COOLING SYSTEM LENNOX GCS8
ELECTRICAL CONTROLS

PROJECT INFORMATION

Owner/Builder: Trinity University
Contractor:
Operational Date: September 1976
Total Estimated ERDA Funds: $1,231,393
Building
  Type: Power plant
  Area: 284,928 sq.ft.(of buildings served)
Location: San Antonio, Texas
Latitude: 29.5°N
Climatic Data

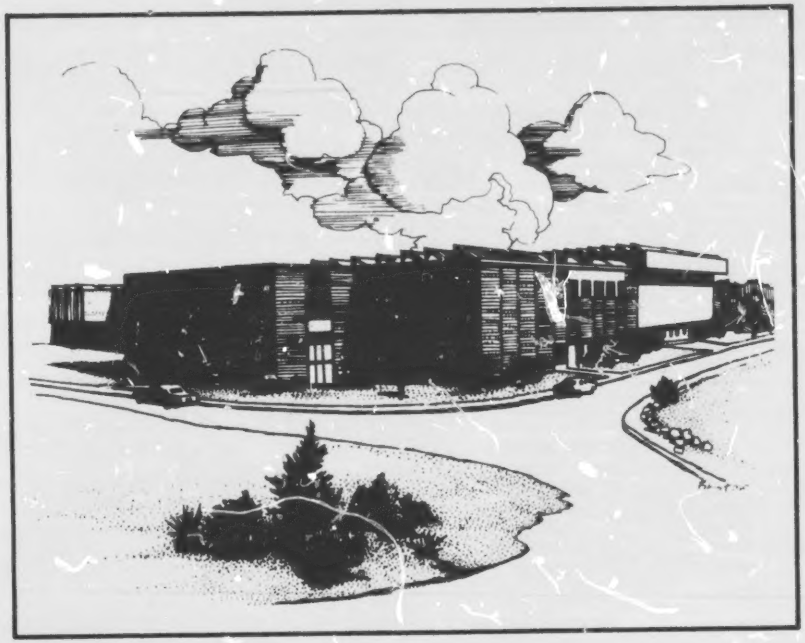
Degree Days	Heating	1570	Cooling	2994
Avg. Temp. (°F)	Winter	55.8	Summer	78.1
Avg. Insol.(Ly/d)	Winter	299	Summer	515

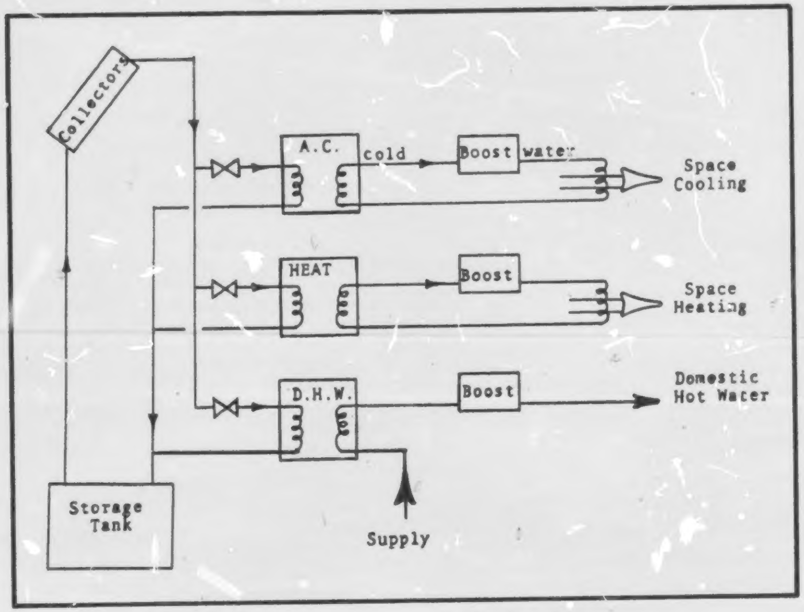
SOLAR ENERGY SYSTEM

Application Heating 85% Cooling ✓ Hot Water 85%
Collector
  Type: Fresnel Lens, concentrating and tracking
  Area (sq. ft.): 16,080
  Manufacturer: Northrup, Inc.
Storage
  Type: Water
  Capacity: 40,000 gallons
Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

Rooftop collectors will provide energy for the University's existing Energy Plant No. 2. The plant serves an athletic complex known as Sams Memorial Center and six dormitories located on the west side of the campus. A new electric centrifugal chiller, cooling tower, and associated auxiliary equipment will be added. No modifications to the existing HVAC system will be required within the buildings served. Approximately 3% of the collector area will be used as part of an experimental program to optimize efficiency and compare cost benefits for alternative types of solar energy collectors. An instrumentation and data acquisition system will be used to monitor system performance. The project provides facilities for collector performance testing in accordance with the NBS Manual NBS IR74–635, "Method of Testing for Rating Solar Collectors Based on Thermal Performance."





PROJECT INFORMATION

Owner/Builder: American Motor Inns, Inc.
Contractor:
Operational Date: February 1977
Total Estimated ERDA Funds: $331,462
Building
Type: Resort hotel and convention center
Area: 250,000 sq.ft.
Location: St. Thomas, Virgin Islands
Latitude: 18.4°N
Climatic Data

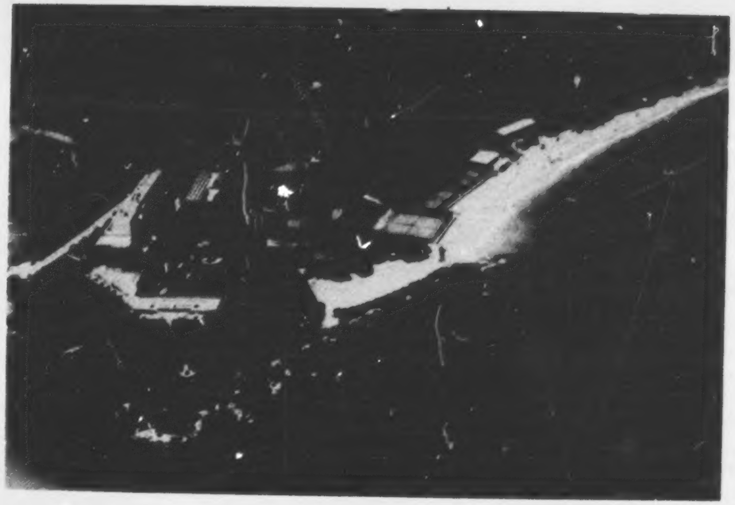
Degree Days	Heating	-	Cooling	4982
Avg. Temp. (°F)	Winter	76.7	Summer	80.6
Avg. Insol.(Ly/d)	Winter	494	Summer	570

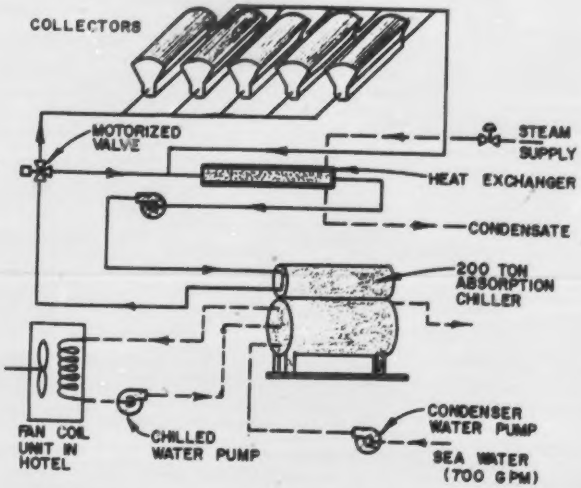
SOLAR ENERGY SYSTEM

Application Heating 0% Cooling ✓ Hot Water 0%
Collector
Type: Evacuated all-glass tube
Area (sq. ft.): 16,000
Manufacturer: Owens-Illinois Company
Storage
Type: None
Capacity:
Auxiliary System Type: Oil fired steam boiler

PROJECT DESCRIPTION

The Frenchman's Reef is a new multi-story resort hotel and convention center with 300 guest rooms and an electrical and mechanical support system. The energy plant currently consumes approximately 1.2 million gallons of oil per year. The solar collector is to be arrayed on three roof surfaces facing south and tilted at a 6° angle. The solar system will provide approximately 54% of the heat requirements for an average of 12 hours per day for one of the two 200-ton absorption chillers. There will be no need for a storage system; the solar contribution will always be less than the minimum air conditioning load. Some of the conservation improvements underway and under consideration involve the capturing and recycling of rainwater to reduce desalination plant load, modification of guest room air conditioning units to operate on low and medium speeds only and recycling the condensate from desalination air ejectors.




COLLECTORS
MOTORIZED VALVE
STEAM SUPPLY
HEAT EXCHANGER
CONDENSATE
200 TON ABSORPTION CHILLER
FAN COIL UNIT IN HOTEL
CHILLED WATER PUMP
CONDENSER WATER PUMP
SEA WATER (700 GPM)

PROJECT INFORMATION

Owner/Builder: Loudoun County School Board
Contractor: Anthony F. Musolino
Operational Date: January 1978
Total Estimated ERDA Funds: $56,336
Building
 Type: Vocational-technical school
 Area:
Location: Leesburg, Virginia
Latitude: 39.1°N

Climatic Data

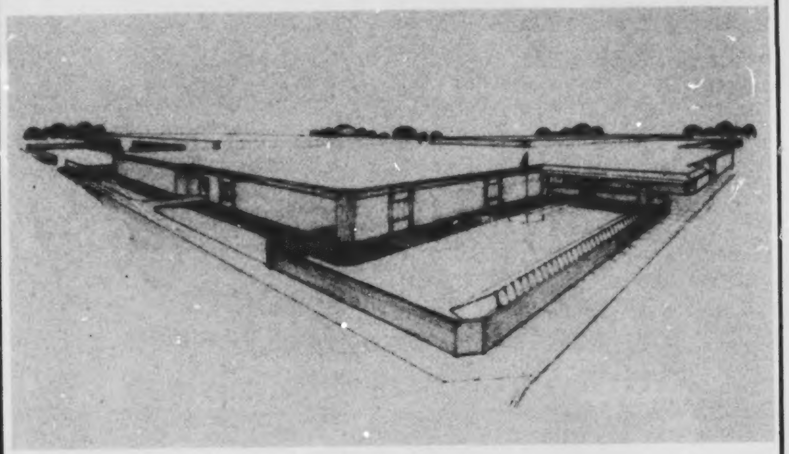
Degree Days	Heating	4503	Cooling	1284
Avg. Temp. (°F)	Winter	41.6	Summer	69.4
Avg. Insol.(Ly/d)	Winter	247	Summer	485

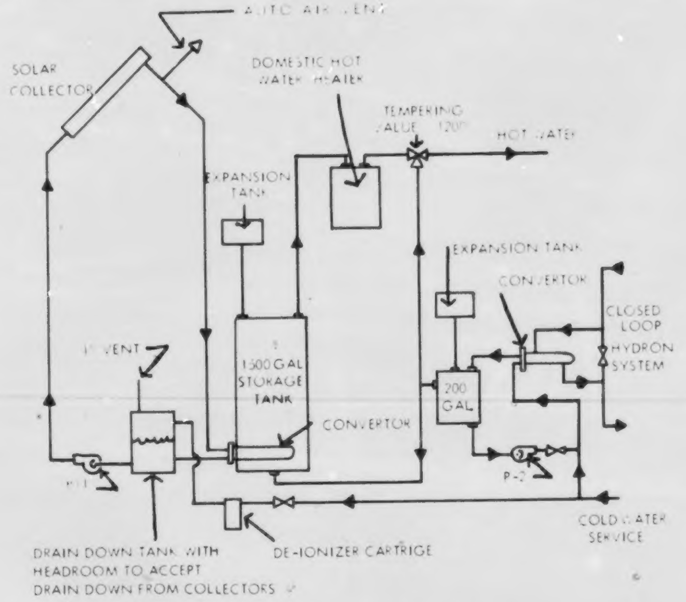
SOLAR ENERGY SYSTEM

Application Heating 0% Cooling 0% Hot Water ✓
Collector
 Type: Flat-plate
 Area (sq. ft.): 1,225
 Manufacturer: To be determined
Storage
 Type: Water
 Capacity: 1,500 gallons
Auxiliary System Type: Electric hot water boiler

PROJECT DESCRIPTION

This project requires the installation of a solar energy water heating system in the Loudoun County Vocational-Technical Education Center. The design for the hot water system is unique in its use of building waste heat to preheat the water. The waste heat used is that generated by the pumps that circulate air in the building. In the past, this excess heat would have been carried by a condenser system to cooling towers and dissipated in the air. The current design calls for the use of a converter to work with the condenser system to preheat the water which would then be raised to its proper temperature by heat gathered in the solar collectors. The solar collectors are located on the ground near the building, rather than on its roof, and are surrounded by stone walls that blend with the building walls. They enclose a courtyard that can be used for classes or meetings, and they also undergo less wind-induced thermal loss than they would if they were located on the building's roof.




AUTO AIR VENT
SOLAR COLLECTOR
DOMESTIC HOT WATER HEATER
TEMPERING VALUE 120°
HOT WATER
EXPANSION TANK
EXPANSION TANK
CONVERTOR
CLOSED LOOP HYDRON SYSTEM
1" VENT
1500 GAL STORAGE TANK
200 GAL
CONVERTOR
P-1
P-2
COLD WATER SERVICE
DRAIN DOWN TANK WITH HEADROOM TO ACCEPT DRAIN DOWN FROM COLLECTORS
DE-IONIZER CARTRIGE

DIAGRAMMATIC FLOW SYSTEM

PROJECT INFORMATION

Owner/Builder: Terrell D. Moseley
Contractor: Terrell D. Moseley
Operational Date: November 1976
Total Estimated ERDA Funds: $15,630
Building
  Type: Office
  Area: 1,780 sq.ft.
Location: Lynchburg, Virginia
Latitude: 37.3°N
Climatic Data

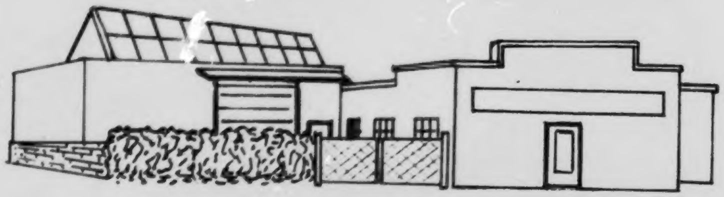
Degree Days	Heating 4233	Cooling 1100
Avg. Temp. (°F)	Winter 45.7	Summer 71.2
Avg. Insol.(Ly/d)	Winter 287	Summer 505

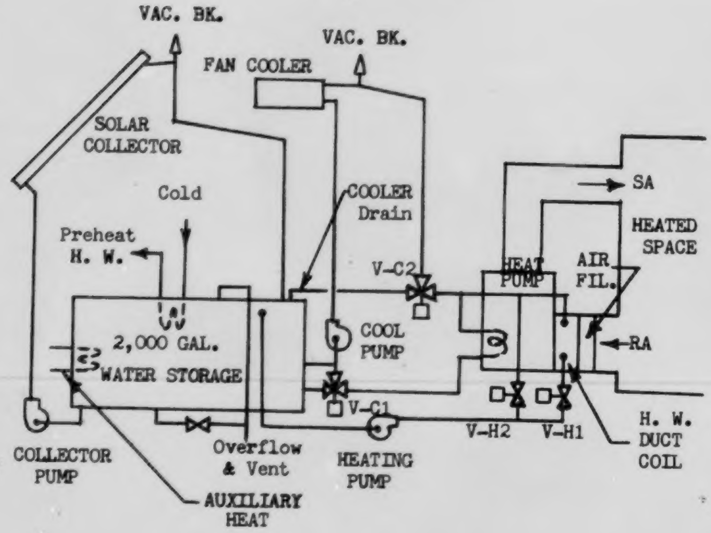
SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling 0% Hot Water ✓
Collector
  Type: Flat-plate
  Area (sq. ft.): 410
  Manufacturer: Terrell Moseley, Inc.
Storage
  Type: Water
  Capacity: 1,200 gallons
Auxiliary System Type: Gas fired

PROJECT DESCRIPTION

This project calls for the space and hot water heating of a one-story cement block office building. A packaged water-to-air heat pump will force heat to the offices through a conventional insulated duct system. Heat will be supplied to the evaporator of the pump by a south-facing solar collector array on the building's roof. Heat collected by the array will be transmitted to a steel storage tank and then relayed to the pump. The storage tank will also be used to preheat water needed in the building. The preheated water will be brought to its required temperature by a gas fired hot water heater. The total heating and cooling system has a design life in excess of 20 years, but some items – motors, compressors, domestic water tanks, etc. – may have to be replaced sooner.




VAC. BK.
VAC. BK.
FAN COOLER
SOLAR COLLECTOR
Cold
Preheat H. W.
COOLER Drain
V-C2
SA
HEATED SPACE
HEAT PUMP
AIR FIL.
RA
2,000 GAL. WATER STORAGE
COOL PUMP
V-C1
V-H2
V-H1
H. W. DUCT COIL
COLLECTOR PUMP
Overflow & Vent
HEATING PUMP
AUXILIARY HEAT

PROJECT INFORMATION

Owner/Builder: Fauquier County

Contractor: Inter Technology Corporation

Operational Date: March 1974

Total Estimated ERDA Funds: $535,000

Building
  Type: School classrooms (5 temporary)
  Area: 4,100 sq.ft.

Location: Warrenton, Virginia

Latitude: 38.9°N

Climatic Data

Degree Days	Heating	4217	Cooling	1330
Avg. Temp. (°F)	Winter	43.1	Summer	70.0
Avg. Insol.(Ly/d)	Winter	269	Summer	489

SOLAR ENERGY SYSTEM

Application	Heating	60%	Cooling	0%	Hot Water	0%

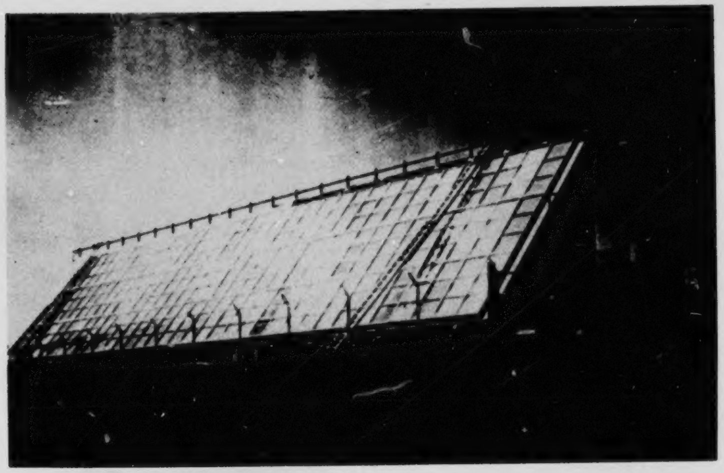
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 2,540
  Manufacturer: Olin Brass Company

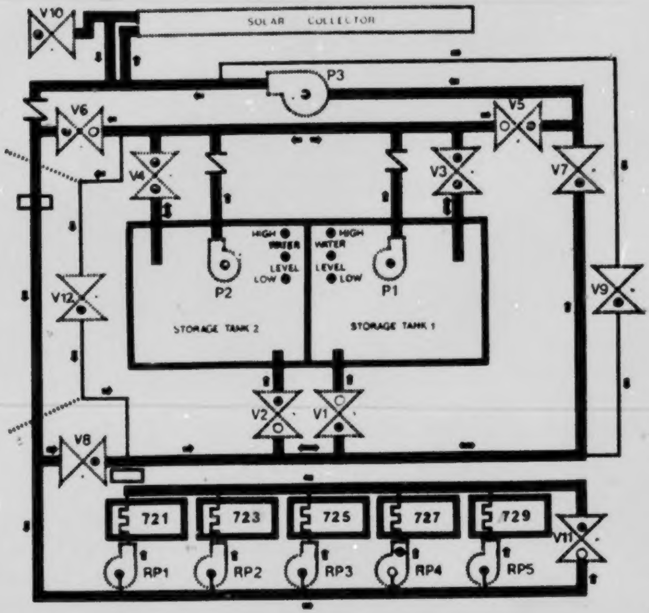
Storage
  Type: Water
  Capacity: 10,000 gallons

Auxiliary System Type: Electric, oil

PROJECT DESCRIPTION

This project aimed at determining whether solar energy could supply a substantial part of the heating requirements of a school, at estimating the cost of installing and maintaining such a system, and at determining the savings in fuel that would be realized from its installation. The system was developed and became operational early in 1974. Since that time it has supplied all heating requirements of the five detached classrooms that it was designed to serve. System efficiency for full day heating ranges between 40 and 60%. The total thermal storage system, which uses 10,000 gallons of water as a storage medium, can meet all heating requirements for twelve days without sunlight. The solar collector constructed for this project consists of 2540 square feet of collector surface, the collector modules being assembled on a support structure measuring 126 ft. by 26 ft.





PROJECT INFORMATION

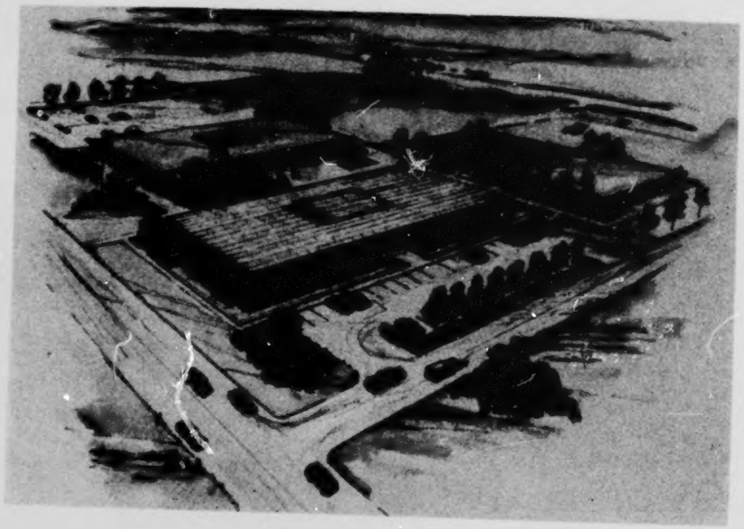
Owner/Builder: Development Dynamics of Richland
Contractor:
Operational Date: January 1977
Total Estimated ERDA Funds: $592.456
Building
  Type: Office
  Area: 14,400 sq.ft.
Location: Richland, Washington
Latitude: 46.3°N

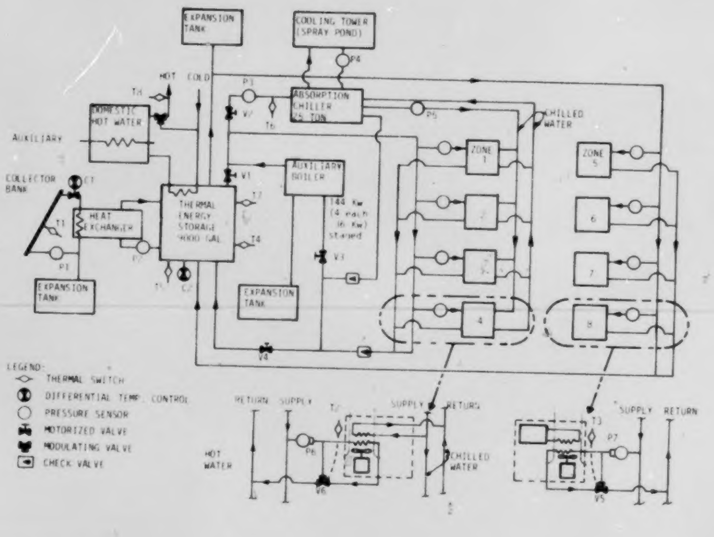
Climatic Data

Degree Days	Heating	4836	Cooling	862
Avg. Temp. (°F)	Winter	45.8	Summer	70.5
Avg. Insol.(Ly/d)	Winter	255	Summer	553

SOLAR ENERGY SYSTEM

Application Heating 55% Cooling 72% Hot Water 90%
Collector
  Type: Flat-plate
  Area (sq. ft.): 8,000
  Manufacturer: General Electric Co.
Storage
  Type: Water
  Capacity: 9,000 gallons
Auxiliary System Type: Electric




EXPANSION TANK
COOLING TOWER (SPRAY POND)
P4
HOT
COLD
T8
P3
DOMESTIC HOT WATER
V7
T6
ABSORPTION CHILLER 25 TON
P5
CHILLED WATER
AUXILIARY
V1
AUXILIARY BOILER
ZONE 1
ZONE 5
COLLECTOR BANK
C1
T1
HEAT EXCHANGER
THERMAL ENERGY STORAGE 9000 GAL
T7
T4
144 Kw (4 each 36 Kw) staged
V3
2
3
4
6
7
8
P1
P2
T5
C2
EXPANSION TANK
EXPANSION TANK
V4
LEGEND:
THERMAL SWITCH
DIFFERENTIAL TEMP. CONTROL
PRESSURE SENSOR
MOTORIZED VALVE
MODULATING VALVE
CHECK VALVE
RETURN
SUPPLY
T2
SUPPLY
RETURN
HOT WATER
P6
V6
CHILLED WATER
T3
SUPPLY
RETURN
P7
V5

PROJECT DESCRIPTION

This demonstration site, in the desert of south central Washington State, is adjacent to and readily visible from a principal north-south traffic artery in Richland. The design involves two identical single-story office buildings in a four-building complex known as Hanford Square. The buildings, each with a capacity of about 100 persons, will have the same external climatographic exposure and nearly identical internal environmental conditions. One building, heated and cooled solely by electrical systems, will act as a control, furnishing power data needed to compute solar energy input as a percentage of total power consumed. Energy conserving features incorporated into the solar building will include solar ponds, dual purpose absorption/reflection venetian blinds, solar panel insulation and double windows. Energy conserving features unrelated to the solar system will be duplicated in both buildings.

PROJECT INFORMATION

Owner/Builder: City of Charles Town School Board

Contractor: Jefferson County Schools

Operational Date: December 1976

Total Estimated ERDA Funds: $755,000

Building
  Type: School
  Area: 50,600 sq.ft.

Location: Charles Town, West Virginia

Latitude: 38.4°N

Climatic Data

Degree Days	Heating	4590	Cooling	1055
Avg. Temp. (°F)	Winter	46.8	Summer	72.0
Avg. Insol.(Ly/d)	Winter	285	Summer	485

SOLAR ENERGY SYSTEM

Application Heating 85% Cooling 52% Hot Water 0%

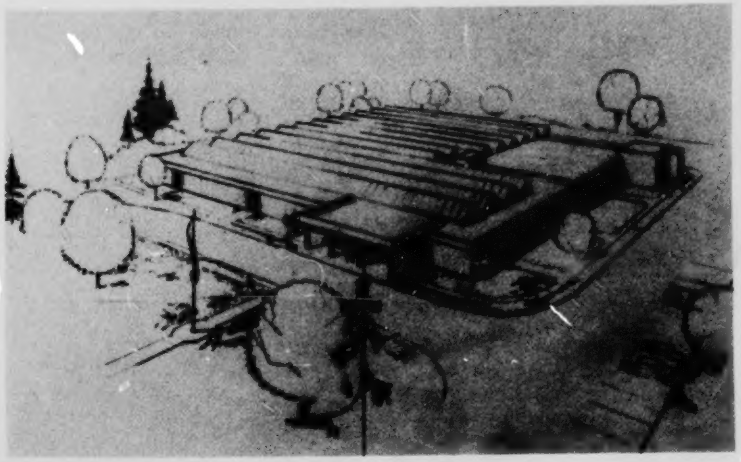
Collector
  Type: Flat-plate/reflector
  Area (sq. ft.): 11,160/9,540
  Manufacturer: Pittsburgh Plate Glass, Inc.

Storage
  Type: Water
  Capacity: 17,000 gallons

Auxiliary System Type: Oil fired boiler

PROJECT DESCRIPTION

This project is for the use of a solar energy system to provide heating, cooling, and hot water heating for the Page Jackson School, now being constructed in Jefferson County, West Virginia. The system will utilize flat-plate collectors, roof-top reflectors, a water storage tank, a 100-ton absorption chiller, and a 100-ton conventional backup chiller. The roof will have several skylights which should appreciably reduce the need for electric lighting. The school has been designed for minimal energy utilization for heating and cooling requirements.

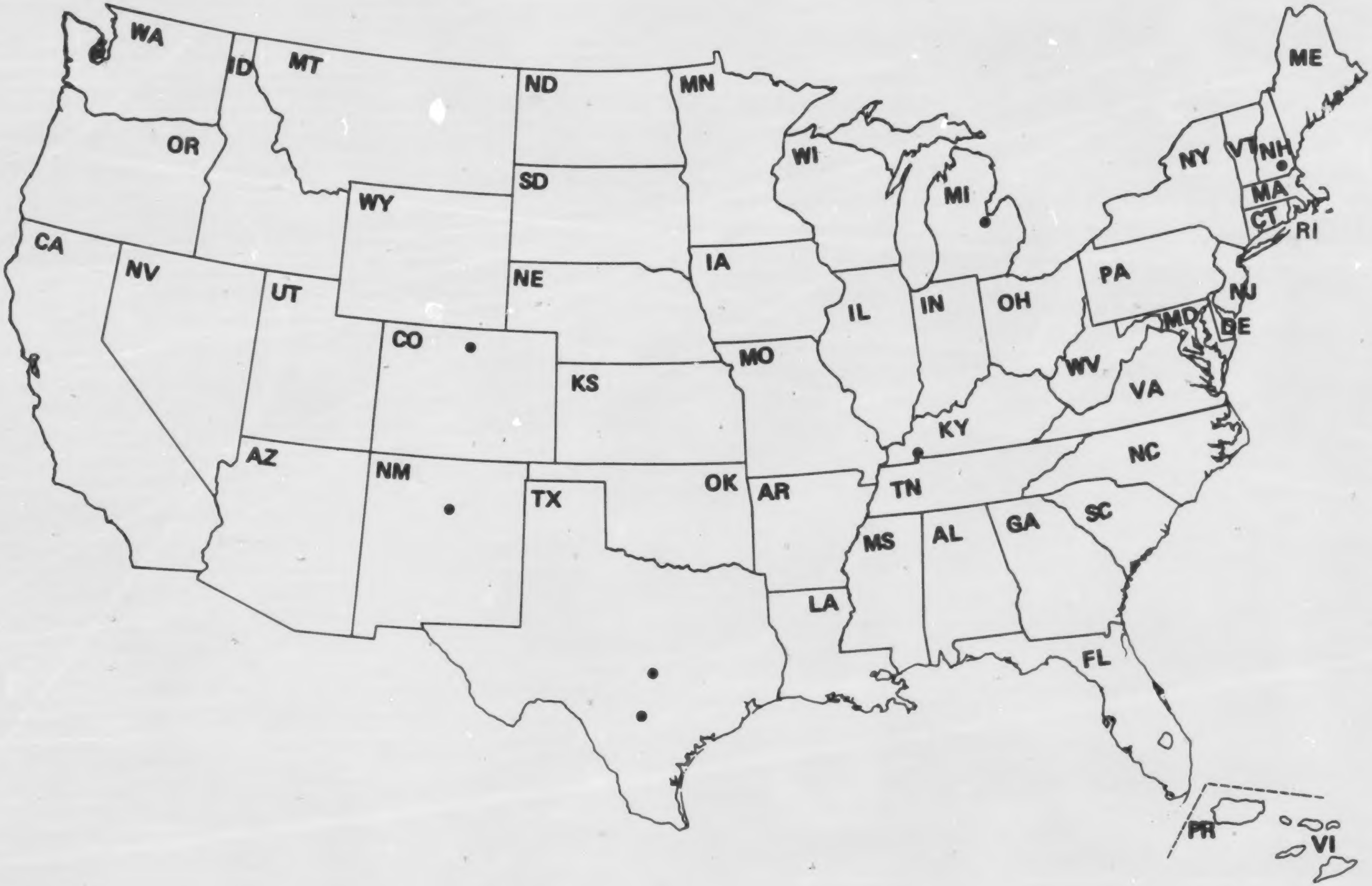


Solar system sketch not available

SECTION II

COMMERCIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

COMMERCIAL DEMONSTRATION PROGRAM
FEDERAL BUILDINGS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123

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SECTION II COMMERCIAL DEMONSTRATION PROGRAM
FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/BUILDER	BUILDING TYPE	SOLAR APPLICATION		
62	COLORADO	Boulder	U.S. Postal Service	Post Office	H	C	HW
63	KENTUCKY	Land-Between-the-Lakes	Tennessee Valley Authority	Visitor's Center	H	C	HW
64	MICHIGAN	Saginaw	Gen. Services Admin.	Office	H	C	HW
65	NEW HAMPSHIRE	Manchester	Gen. Services Admin.	Office	H	C	HW
66	NEW MEXICO	Kirtland AFB	Dept. of Defense	Exch. Shopping Center	H	C	HW
67	TEXAS	Ft. Hood	Dept. of Defense	Office/classroom	H	C	
68		Randolph AFB	Dept. of Defense	Exch. Shopping Center	H	C	HW

NOTE

Since the finalization of this document the following additional projects have been initiated or are in the process of being initiated. Information pertaining to these projects will be included in subsequent revisions.

CALIFORNIA	San Diego	Veterans Admin.	Hospital	H		HW
TEXAS	Bastrop	Gen. Services Admin/ Dept. of Justice	Youth Center	H	C	HW

PROJECT INFORMATION

Owner/Builder: U.S. Postal Service
Contractor: Honeywell
Operational Date: June 1977
Total Estimated ERDA Funds: $56,300(system eng. & req'ts)
Building
Type: Post office
Area: 30,000 sq.ft.(total); 29,380(conditioned)
Location: Boulder, Colorado
Latitude: 40.0°N
Climatic Data

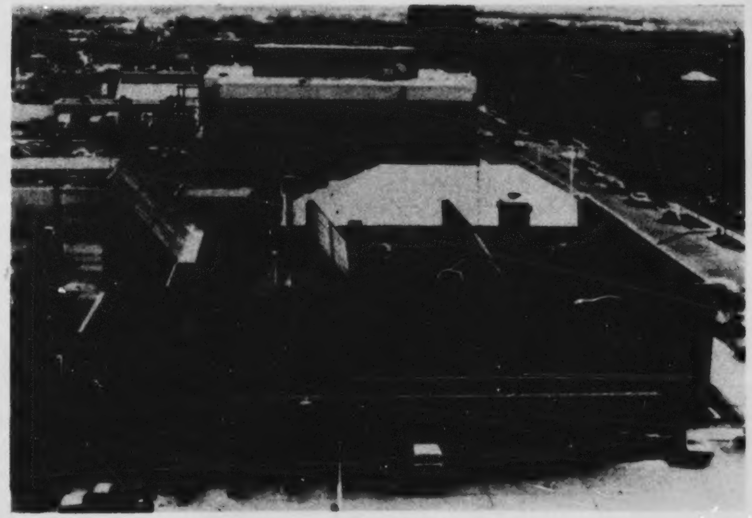
Degree Days	Heating	6276	Cooling	566
Avg. Temp. (°F)	Winter	42.5	Summer	69.3
Avg. Insol.(Ly/d)	Winter	383	Summer	624

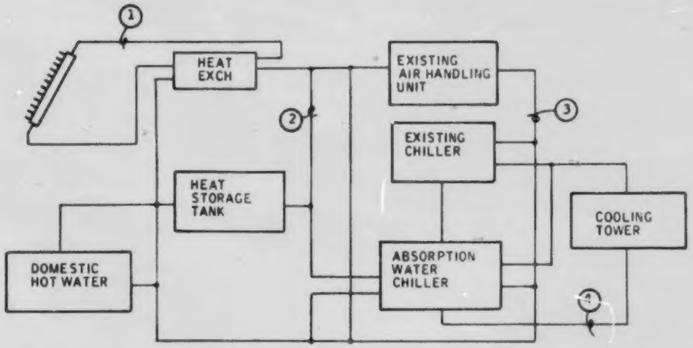
SOLAR ENERGY SYSTEM

Application Heating ✓ Cooling ✓ Hot Water ✓
Collector
Type: Steel absorber flat-plate w/copper waterways
Area (sq. ft.): 4,356
Manufacturer: Lennox Industries-Honeywell, Inc.
Storage
Type: Water
Capacity: 6,000 gallons
Auxiliary System Type: Gas fired boiler, electric

PROJECT DESCRIPTION

An existing U.S. Postal Service building will be retrofitted with a solar energy system. The two-story Post Office was constructed during the 1920's. Two major additions were made, the first in 1931 and the second in 1959. This project is regarded as a prototype with which to demonstrate the technical and economic feasibility of retrofitting other similar facilities in the U.S. After initial testing, all systems will be operated by the Postal Service personnel normally assigned to building operation and maintenance; emphasis will be placed on making all component parts reliable and easily maintained. The contractor will be required to document his methods of defining criteria for system design; his rationale for system, subsystem and component selection; and his design procedures.





PROJECT INFORMATION

Owner/Builder: Tennessee Valley Authority

Contractor:

Operational Date: April 1978

Total Estimated ERDA Funds: $170,000

Building
  Type: Visitor's center
  Area: 10,600 sq.ft.

Location: Land-Between-the-Lakes, Kentucky

Latitude: 37°N

Climatic Data

Degree Days	Heating	Cooling
Avg. Temp. (°F)	Winter	Summer
Avg. Insol.(Ly/d)	Winter	Summer

SOLAR ENERGY SYSTEM

Application Heating 91% Cooling 37% Hot Water 91%

Collector
  Type: Flat-plate
  Area (sq. ft.): 1,000
  Manufacturer:

Storage
  Type: Water
  Capacity: 15,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This project involves the design and construction of a solar energy heating and cooling system for the visitors center that the Tennessee Valley Authority will construct in Land Between the Lakes, Kentucky. After it is completed in 1978, this center will have an estimated 2 million visitors each year. The system to be installed uses a flat-plate collector, multiple heat pumps, chillers, heat exchangers, and related equipment. Plans for the system should be completed by August 1976, and construction will begin in the spring of 1977. Because it will be installed in a visitors' center, the system will acquaint large numbers of people with the benefits of solar energy heating and cooling systems.

Solar system sketch not available

PROJECT INFORMATION

Owner/Builder: General Services Administration

Contractor: Gilbane Building Company

Operational Date: November 1976

Total Estimated ERDA Funds: $471,000

Building
  Type: Office
  Area: 59,500 sq.ft.

Location: Saginaw, Michigan

Latitude: 43.4°N

Climatic Data

Degree Days	Heating	7420	Cooling	383
Avg. Temp. (°F)	Winter	38.5	Summer	66.9
Avg. Insol.(Ly/d)	Winter	292	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 60% Hot Water 100%

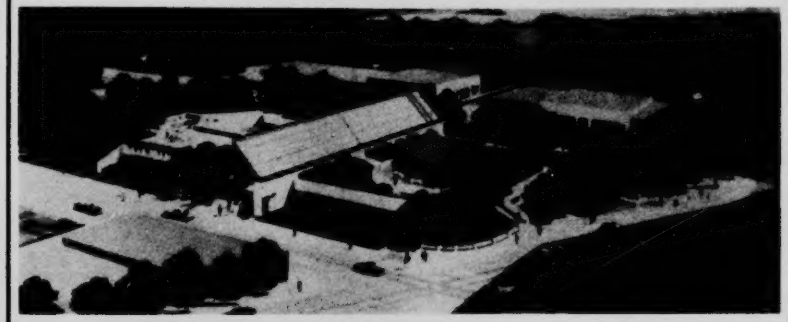
Collector
  Type: Evacuated tube
  Area (sq. ft.): 8,000
  Manufacturer:

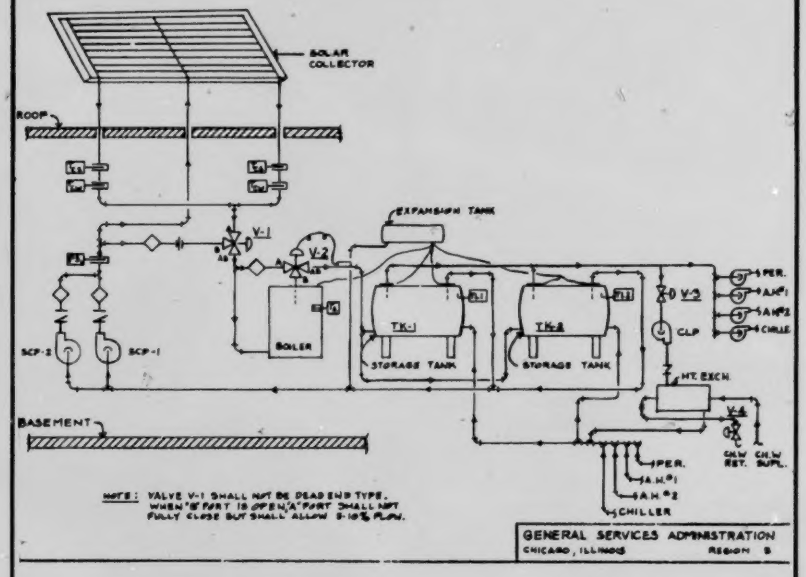
Storage
  Type: Water
  Capacity: 30,000 gallons

Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project involves the fabrication, installation and evaluation of an advanced experimental solar collector array on a federal office building. The building design includes numerous innovative and experimental environmental and energy conserving features and systems. It was awarded a Design Citation in the 1974 Annual Progressive Architecture Awards Program and was a winner of the Governmental Category in the 1974 Owens-Corning Fiberglas Energy Conservation Awards Program. The completed building is expected to operate with 40 to 50% less energy than typical modern buildings of comparable size and subjected to similar climatic conditions. The building and the solar energy system will serve as a study model for facilities of its type, size, and location. Monitoring and evaluation of solar energy system performance will be carried out by the University of Michigan over a 12-month period following initial building occupancy.





NOTE: VALVE V-1 SHALL NOT BE DEAD END TYPE. WHEN 'B' PORT IS OPEN, 'A' PORT SHALL NOT FULLY CLOSE BUT SHALL ALLOW 5-10% FLOW.

GENERAL SERVICES ADMINISTRATION
CHICAGO, ILLINOIS REGION 5

PROJECT INFORMATION

Owner/Builder: General Services Administration
Contractor: Davidson Construction Co., Inc.
Operational Date: October 1976
Total Estimated ERDA Funds: $567,000
Building
Type: Office
Area: 131,000 sq.ft.(total); 30,00(cond.)
Location: Manchester, New Hampshire
Latitude: 43.0°N

Climatic Data

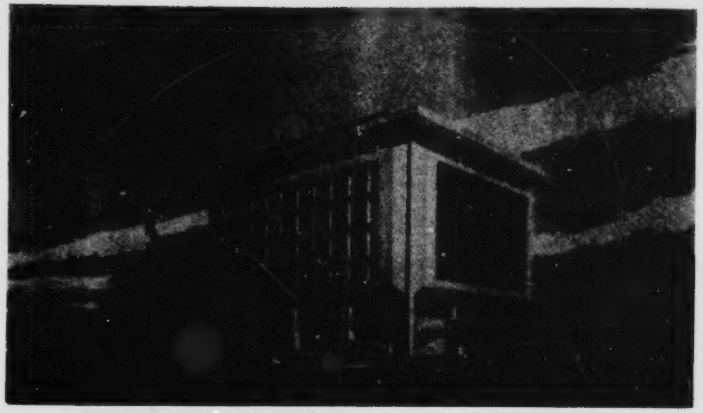
Degree Days	Heating	7360	Cooling	349
Avg. Temp. (°F)	Winter	38.5	Summer	68.5
Avg. Insol.(Ly/d)	Winter	266	Summer	488

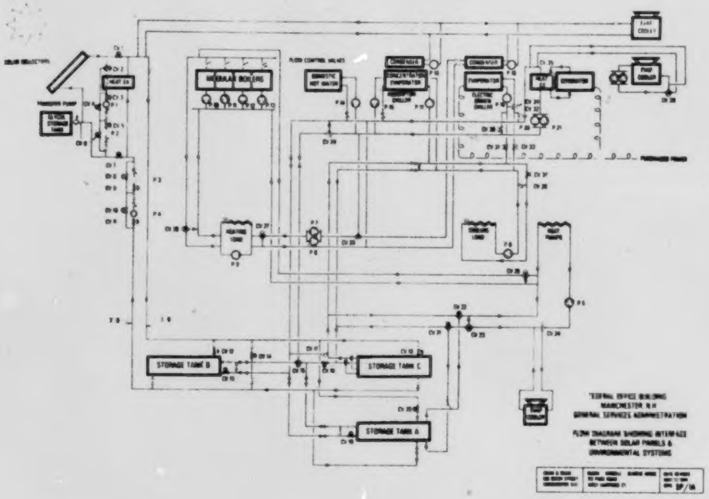
SOLAR ENERGY SYSTEM

Application Heating 30% Cooling 30% Hot Water ✓
Collector
Type: Liquid flat-plate
Area (sq. ft.): 4,600
Manufacturer: Multi-source
Storage
Type: Water
Capacity: 30,000 gallons
Auxiliary System Type: Gas fired boiler

PROJECT DESCRIPTION

This project is for the solar system addition to the Federal Office Building being constructed in Manchester, New Hampshire. The seven-story building has been designated by the General Services Administration (GSA) as its Energy Conservation Demonstration Building, and a variety of energy conservation techniques will be used and tested in its construction and operation. Under optimum conditions the supplementary solar system which will utilize a 25-ton absorption chiller, a conventional 65-ton electrically driven chiller, and three 10,000-gallon insulated tanks should be capable of supplying nearly all of the building's energy requirements. Different mechanical and electrical systems will be used for heating, cooling, and lighting; and the most effective systems will be determined through evaluations made by GSA and the National Bureau of Standards. The building will use up to 40% less energy than would be used by a conventional office building in the same area.




SOLAR COLLECTORS
HEAT EX
MODULAR BOILERS
FLOW CONTROL VALVES
DOMESTIC HOT WATER
CONDENSER
CONCENTRATOR EVAPORATOR
EVAPORATOR
HEATING LOAD
STORAGE TANK B
STORAGE TANK C
STORAGE TANK A
FEDERAL OFFICE BUILDING
MANCHESTER N.H.
GENERAL SERVICES ADMINISTRATION
FLOW DIAGRAM SHOWING INTERFACE
BETWEEN SOLAR PANELS &
ENVIRONMENTAL SYSTEMS

PROJECT INFORMATION

Owner/Builder: Army & Air Force Exchange Serv.

Contractor:

Operational Date: July 1977

Total Estimated ERDA Funds: $390,000

Building
Type: Exchange shopping center
Area: 41,000 sq.ft.

Location: Kirtland AFB, New Mexico

Latitude: 35°N

Climatic Data

Degree Days	Heating 4348	Cooling 1250
Avg. Temp. (°F)	Winter 45	Summer 79
Avg. Insol.(Ly/d)	Winter 405	Summer 618

SOLAR ENERGY SYSTEM

Application Heating 98.6% Cooling 78.3% Hot Water 98.6%

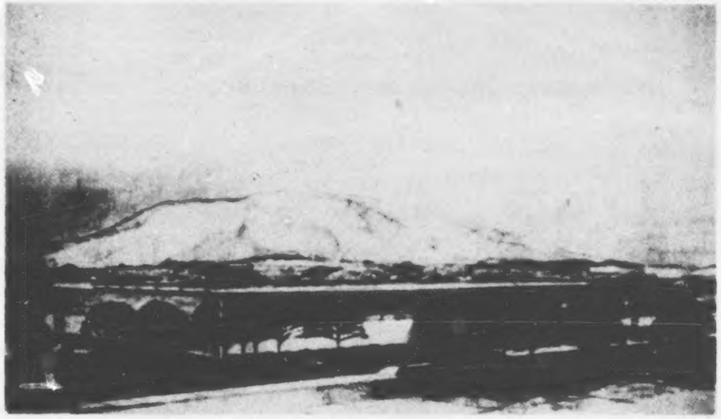
Collector
Type: liquid flat-plate (double pane)
Area (sq. ft.): 9,410
Manufacturer: To be determined

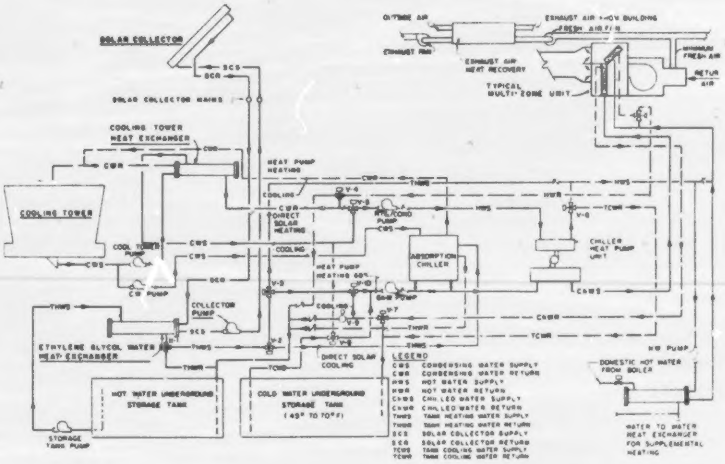
Storage
Type: Water
Capacity: 40,000 gallons

Auxiliary System Type: Electric

PROJECT DESCRIPTION

This project involves the design and installation of a solar energy heating and cooling system for an Air Force base exchange. The solar system will interface with the mechanical heating and cooling system planned for the facility. The mechanical system will be capable of meeting all of the facility's heating requirement. Data compiled in the project will be useful to those designing heating and cooling systems for private retail business.




SOLAR COLLECTOR
SCS
SCR
SOLAR COLLECTOR MAINS
OUTSIDE AIR
EXHAUST AIR FROM BUILDING
FRESH AIR FAN
EXHAUST FAN
EXHAUST AIR HEAT RECOVERY
MINIMUM FRESH AIR
RETURN AIR
TYPICAL MULTI-ZONE UNIT
COOLING TOWER HEAT EXCHANGER
CWR
HEAT PUMP HEATING
COOLING TOWER
COOLING
DIRECT SOLAR HEATING
V-4
V-5
V-6
HTG/COND PUMP
HWS
HWR
TCWR
THWS
THWR
CWS
COOL TOWER PUMP
CW PUMP
ABSORPTION CHILLER
CHILLER HEAT PUMP UNIT
HEAT PUMP HEATING 60%
V-10
V-3
V-2
V-7
V-8
V-9
GEN PUMP
CHWS
CHWR
COLLECTOR PUMP
E-1
ETHYLENE GLYCOL WATER HEAT EXCHANGER
DIRECT SOLAR COOLING
TCWS
HOT WATER UNDERGROUND STORAGE TANK
COLD WATER UNDERGROUND STORAGE TANK (45° TO 70°F)
STORAGE TANK PUMP
HW PUMP
DOMESTIC HOT WATER FROM BOILER
WATER TO WATER HEAT EXCHANGER FOR SUPPLEMENTAL HEATING
LEGEND
CWS CONDENSING WATER SUPPLY
CWR CONDENSING WATER RETURN
HWS HOT WATER SUPPLY
HWR HOT WATER RETURN
CHWS CHILLED WATER SUPPLY
CHWR CHILLED WATER RETURN
THWS TANK HEATING WATER SUPPLY
THWR TANK HEATING WATER RETURN
SCS SOLAR COLLECTOR SUPPLY
SCR SOLAR COLLECTOR RETURN
TCWS TANK COOLING WATER SUPPLY
TCWR TANK COOLING WATER RETURN

PROJECT INFORMATION

Owner/Builder: Dept. of Army, Ft. Worth Dist., Corp of Eng.

Contractor: General Electric/Lycla Inc.

Operational Date: November 1976

Total Estimated ERDA Funds: $588,000

Building
  Type: Battalion Headquarters/classroom
  Area: 12,200 sq.ft.

Location: Ft. Hood, Texas

Latitude: 31.1°N

Climatic Data

Degree Days	Heating 1950	Cooling 2802
Avg. Temp. (°F)	Winter 49	Summer 83
Avg. Insol.(Ly/d)	Winter 285	Summer 501

SOLAR ENERGY SYSTEM

Application Heating 98% Cooling 83% Hot Water 0%

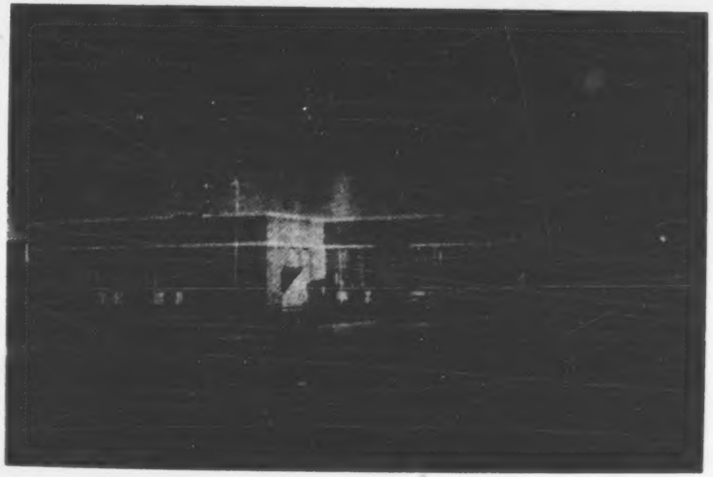
Collector
  Type: Flat-plate
  Area (sq. ft.): 6,000
  Manufacturer: General Electric Co.

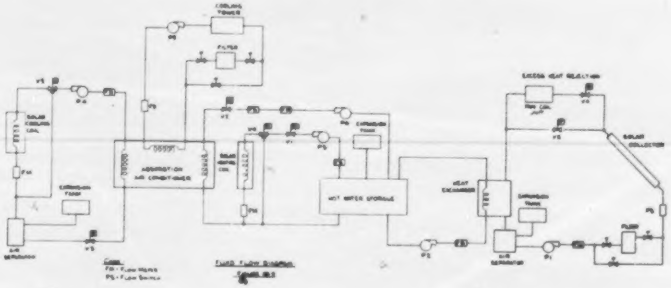
Storage
  Type: Water
  Capacity: 12,000 gallons

Auxiliary System Type: Central Energy Plant

PROJECT DESCRIPTION

This proof-of-concept experiment will incorporate a solar energy system in a battalion headquarters and classroom building authorized for construction under the fiscal 1975 Military Construction Army Program. Solar collectors will be mounted above the roof on a structural grid and aligned with the building axis facing in a generally southern direction at a tilt of 20 degrees. The buried thermal energy storage tank and the system cooling tower will be located on the west side of the building. An ethylene glycol water solution will be circulated through the collector loop. Cooling will be provided by circulating hot storage water through a 100-ton absorption chiller which supplies chilled water to coils in the building air duct system. The instrumentation system will monitor system performance and provide data for evaluation of energy supplied. A display panel will provide a graphic display of system operation along with direct readout of operating conditions and system temperatures.




COOLING TOWER
FILTER
SOLAR COOLING COIL
ABSORPTION AIR CONDITIONER
SOLAR HEATING COIL
EXPANSION TANK
HOT WATER STORAGE
HEAT EXCHANGER
EXCESS HEAT REJECTION
FAN COIL UNIT
SOLAR COLLECTOR
AIR SEPARATOR
CODE
FM - FLOW METER
FS - FLOW SWITCH
FLUID FLOW DIAGRAM

PROJECT INFORMATION

Owner/Builder: Army & Air Force Exchange Serv.

Contractor:

Operational Date: October 1977

Total Estimated ERDA Funds: $510,000

Building

Type: Exchange shopping center

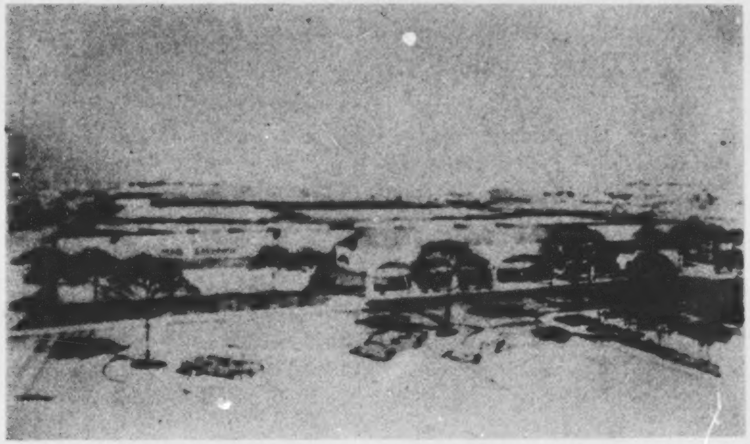
Area: 62,000 sq.ft.

Location: Randolph AFB, Texas

Latitude: 29.5°N

Climatic Data

Degree Days	Heating 1546	Cooling 2990
Avg. Temp. (°F)	Winter 60	Summer 78
Avg. Insol.(L/d)	Winter 340	Summer 545



SOLAR ENERGY SYSTEM

Application Heating 99.7% Cooling 64% Hot Water 99.7%

Collector

Type: liquid flat-plate (double pane)

Area (sq. ft.): 14,700

Manufacturer: To be determined

Storage

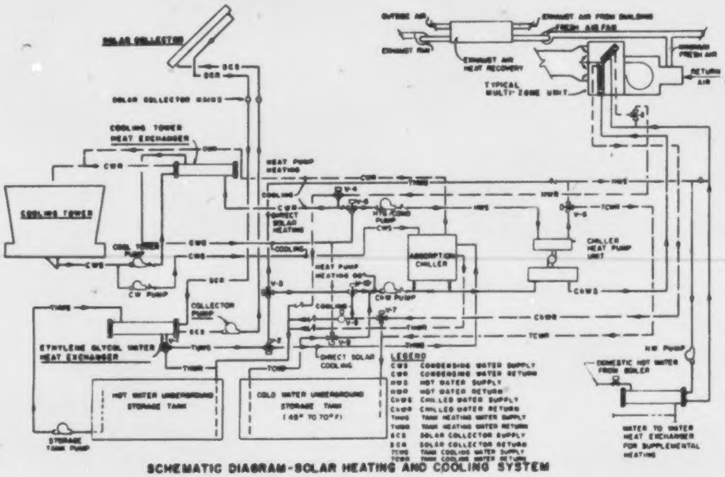
Type: Water

Capacity: 50,000 gallons

Auxiliary System Type: Oil

PROJECT DESCRIPTION

The project involves the design and construction of a solar energy system that would meet a large part of the heating and cooling requirements of an Air Force base exchange shopping center. The center is to consist of a large retail sales area, concession shops, mall, administrative offices and storage facilities. The solar energy system will be interfaced with a backup heating and air conditioning system capable of meeting design requirements of the facility.

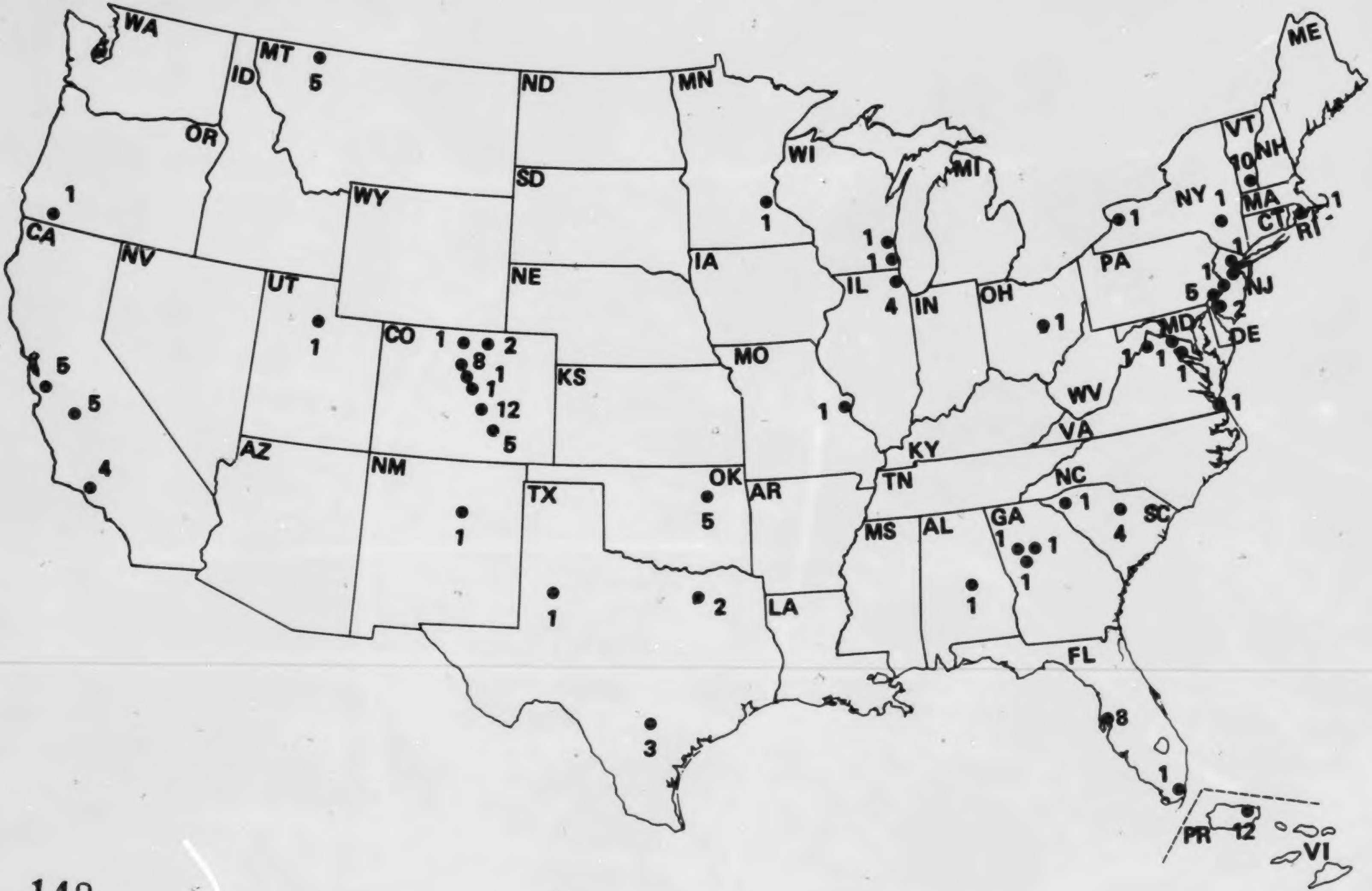

SOLAR COLLECTOR
SCS
SCR
SOLAR COLLECTOR BANKS
OUTSIDE AIR
EXHAUST FAN
EXHAUST AIR FROM BUILDING
FRESH AIR FAN
EXHAUST AIR HEAT RECOVERY
MINIMUM FRESH AIR
RETURN AIR
TYPICAL MULTI-ZONE UNIT
COOLING TOWER HEAT EXCHANGER
COOLING TOWER
CWR
CWS
HEAT PUMP HEATING
COOLING
DIRECT SOLAR HEATING
V-4
V-5
V-6
V-3
V-7
V-8
V-2
V-1
HYDRONIC PUMP
HWS
HWR
TCWR
TCWS
CHWS
CHWR
TWHS
TWHR
ABSORPTION CHILLER
CHILLER HEAT PUMP UNIT
COOL TOWER PUMP
CW PUMP
HEAT PUMP HEATING ONLY
CHW PUMP
COLLECTOR PUMP
ETHYLENE GLYCOL WATER HEAT EXCHANGER
DIRECT SOLAR COOLING
HOT WATER UNDERGROUND STORAGE TANK
COLD WATER UNDERGROUND STORAGE TANK (45° TO 70° F)
STORAGE TANK PUMP
HW PUMP
DOMESTIC HOT WATER FROM BOILER
WATER TO WATER HEAT EXCHANGER FOR SUPPLEMENTAL HEATING
LEGEND
CWS CONDENSING WATER SUPPLY
CWR CONDENSING WATER RETURN
HWS HOT WATER SUPPLY
HWR HOT WATER RETURN
CHWS CHILLED WATER SUPPLY
CHWR CHILLED WATER RETURN
TWHS TANK HEATING WATER SUPPLY
TWHR TANK HEATING WATER RETURN
SCS SOLAR COLLECTOR SUPPLY
SCR SOLAR COLLECTOR RETURN
TCWS TANK COOLING WATER SUPPLY
TCWR TANK COOLING WATER RETURN

SCHEMATIC DIAGRAM-SOLAR HEATING AND COOLING SYSTEM

SECTION III

RESIDENTIAL DEMONSTRATION PROGRAM NON FEDERAL BUILDINGS

RESIDENTIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDING UNITS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PA
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UT
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IL
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IN
OH
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5
NJ
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CO
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8
1
1
12
5
MD
DE
5
KS
MO
1
1
1
1
5
1
WV
1
4
VA
AZ
KY
OK
NM
5
TN
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143

SECTION III RESIDENTIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDINGS

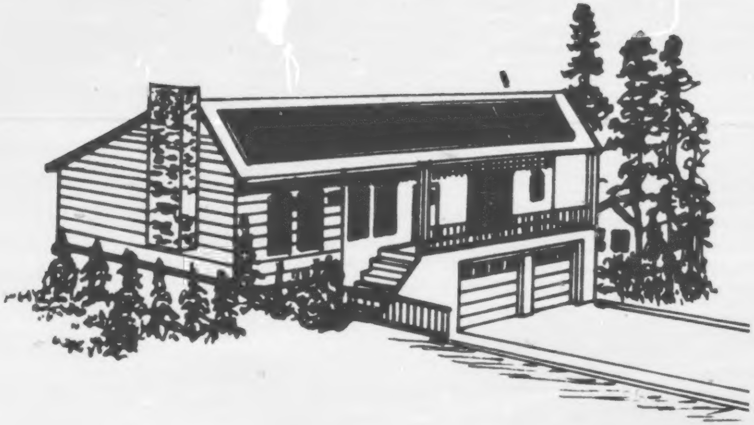
PAGE	STATE	LOCATION	OWNER/BUILDER	NUMBER OF UNITS	BUILDING TYPE	SOLAR APPLICATION			GRANT AMOUNT
71	ALABAMA	Moody	Michael Greene Co.	1	SFD	H		HW	$ 8,000
72	CALIFORNIA	Camarillo	Leisure Tech. of California	4	SFD			HW	4,400
73		Santa Clara	City of Santa Clara	5	SFD	H		HW	40,000
74		Selma	Self-Help Enterprises	5	SFD	H	C		20,350
75	COLORADO	Boulder	Stonebreaker Investments	8	MFLR	H		HW	22,450
76		Colorado Springs	City of Colorado Springs	12	MFLR	H	S	HW	75,492
77		Denver	Perl-Mack Enterprises	1	SFD	H	C	HW	29,158
78		Fort Collins	Eco-Era, Inc.	2	SFD	H	C	HW	6,000
79		Fort Collins	Solar Engineering Co.	1	SFD	H		HW	10,500
80		Pueblo	Pueblo Housing Authority	5	SFD			HW	16,000
81		Westminster	Waverly Homes	1	SFD	H			6,000
82	FLORIDA	Coral Gables	The Babcock Co.	1	SFA/SFD			HW	1,830
83		St. Petersburg	City of St. Petersburg	8	MFLR			HW	9,428
84	GEORGIA	Atlanta	Hooker-Barnes	1	SFD	H		HW	11,411
85		Dacula	Winford Lindsay	1	SFD	H		HW	6,400
86		Shenandoah	Peachtree Homes Inc.	1	SFD	H	C	HW	11,500
87	ILLINOIS	Vernon Hills	United Development Corp.	4	SFA	H	S	HW	40,000
88	MINNESOTA	Bloomington	Marvin H. Anderson Corp.	1	SFD	H		HW	16,250
89	MISSOURI	St. Louis	Kelly/Fisher Co.	1	SFD	H		HW	17,000
90	MONTANA	Browning	Blackfeet Tribe Housing Auth.	5	SFD	H		HW	49,000
91	NEW JERSEY	Blackwood	Korman Corp.	2	SFD	H		HW	31,186
92		Newark	Housing Authority of Newark	1	SFA	H		HW	30,182
93		Old Bridge	Jespa Enterprises	1	SFD	H		HW	10,800
94	NEW MEXICO	Santa Fe	Wayne Nichols Co.	1	SFD	H	S	HW	7,958
95	NEW YORK	Buffalo	Innovative Building System, Inc.	1	SFD	H	S	HW	15,000
96		La Grangeville	Solar Structures, Inc.	1	SFD	H		HW	15,000
97	OHIO	Dublin	Bldg. Ind. Assoc. of Central Ohio	1	SFD	H		HW	19,100

SECTION III RESIDENTIAL DEMONSTRATION PROGRAM
NON FEDERAL BUILDINGS (CONT)

PAGE	STATE	LOCATION	OWNER/BUILDER	NUMBER OF UNITS	BUILDING TYPE	SOLAR APPLICATION			GRANT AMOUNT
98	OKLAHOMA	Tulsa	Creek National Housing Auth.	5	SFD	H		HW	$39,935
99	OREGON	Ashland	Vincent Oredson Co.	1	SFD	H		HW	6,100
100	PENNSYLVANIA	Philadelphia	University of Philadelphia	1	SFA	H		HW	12,980
101		Philadelphia	Drexel University	5	MFLR			HW	6,780
102	PUERTO RICO	Prio Piedras	Puerto Rico Urban Renewal Corp.	12	MFLR			HW	21,000
103	RHODE ISLAND	Newport	Church Community Corp.	1	SFD	H		HW	5,000
104	SOUTH CAROLINA	Columbia	Cambridge Development Group	4	SFA	H		HW	39,000
105		Greenville	Helio Thermics, Inc.	1	SFD	H	S		3,000
106	TEXAS	Dallas	W. Brown Builders	2	SFD	H		HW	37,600
107		Lubbock	Gordon Deering, Jr., Co.	1	SFD	H		HW	9,000
108		San Antonio	San Antonio Ranch, Ltd.	3	SFD	H	C		75,000
109	UTAH	Salt Lake City	Terracor	1	SFA	H		HW	15,000
110	VERMONT	Brookline	Grassy Brook Village	10	SFA	H		HW	66,500
111	VIRGINIA	Alexandria	Rust Construction Co.	1	SFD	H		HW	6,000
112		Berryville	Ritter Buildings, Inc.	1	SFD	H	S	HW	5,886
113		Vienna	The Yeonas Co.	1	SFD			HW	1,875
114		Virginia Beach	Sir Galahad Co.	1	SFD	H		HW	12,500
115	WISCONSIN	Milwaukee	University of Wisconsin	1	SFD	H		HW	13,800
116		Summit	Friedman, Rosen, Zien	1	SFD	H	S	HW	9,732

KEY

SFD	Single Family Detached
SFA	Single Family Attached
MFLR	Multi-Family Low Rise
H	Heating
C	Cooling
S	Storage Assisted Cooling
HW	Hot Water



PROJECT INFORMATION

BUILDER: Michael Greene Company, Inc.

DESIGNERS ARCHITECT: Michael Greene Company, Inc.
ENGINEER : Solaron Corporation

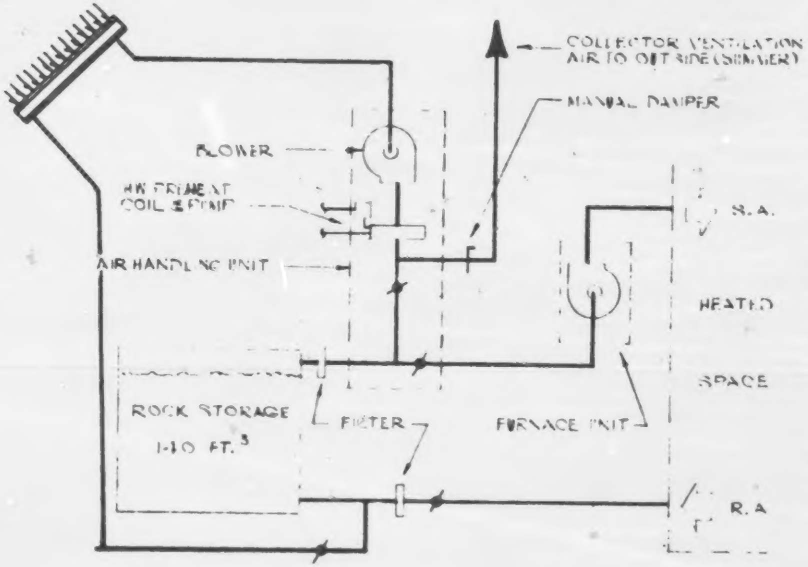
LOCATION: Moody, Alabama Latitude 33°N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: DEGREE DAYS **HEATING** 2,826 **COOLING** 2,580 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 230 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project is a simple two story single family dwelling design modified to include a solar heating and domestic hot water preheating system. The design contains 1,296 square feet of heated floor area not including a two car garage. An assymetrical roof provides optimum tilt for solar radiation collection as well as an extended overhang to shade the many south-facing windows from the hot summer sun. Storm windows, added insulation and a fireplace are additional energy conservation features that improve the thermal performance of the building.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 273 square foot air-cooled flat-plate manufactured by Solaron Corporation with two sheets of tempered glass as the cover plate; south-facing windows.

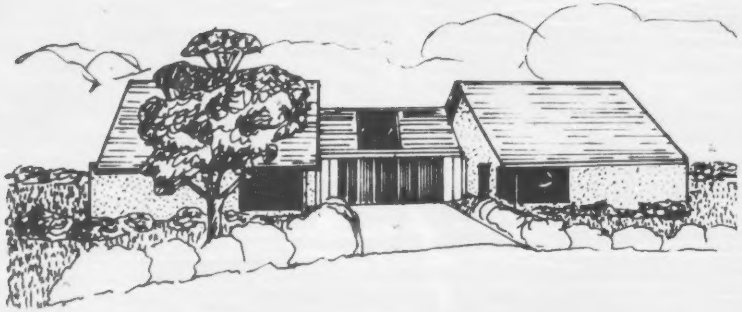
STORAGE: 145 cubic feet of one and one-half inch rock within a 5'-3" x 5'-3" x 6'-9" insulated storage bin located in the lower floor.

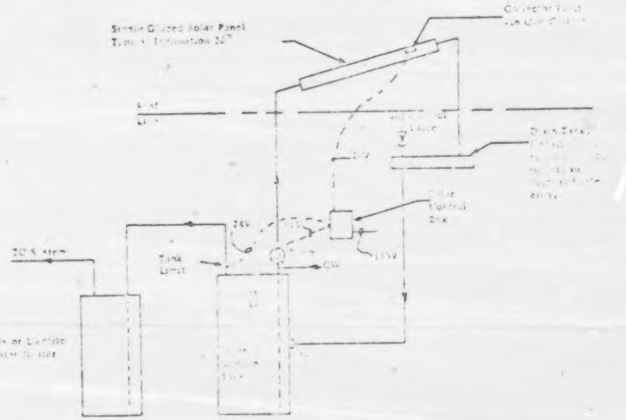
DISTRIBUTION: Forced air, natural radiation and convection. A blower and motor driven dampers are part of the factory pre-assembled air handling module circulating heated air to occupied spaces from collector or storage.

AUXILIARY ENERGY SYSTEM: Gas furnace. In-line with solar system ducts the furnace provides a full or partial energy boost as required.

DOMESTIC HOT WATER SYSTEM: Finned coil located in the air handling module preheats domestic hot water prior to placement in an insulated 80 gallon storage tank. Preheated hot water passes through a conventional water heater.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: Leisure Technology of California, Inc.

DESIGNERS ARCHITECT: Leisure Technology of Calif., Inc.
ENGINEER : Raypak, Inc.

LOCATION: Camarillo, California Latitude 35°N.

HOUSING TYPE: Single Family Attached

CLIMATIC DATA: DEGREE DAYS **HEATING** 2,050 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar domestic hot water preheating system to a 1,200 square foot single family attached dwelling. A single solar collector panel is mounted at the proper orientation and tilt on the dwelling's sloping south-facing roof. The collector is connected to a storage tank located in the basement of the house.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** ____ **COOLING** ____ **DHW** X

COLLECTOR: 18 square feet liquid-cooled flat-plate manufactured by Raypak. The black painted absorber consists of an aluminum surface with copper bonded tubes.

STORAGE: 40 gallons of water within an insulated storage tank located in the basement.

DISTRIBUTION: Domestic water is preheated by the collector and stored in the 40 gallon storage tank. The preheated water passes through a conventional water heat where an energy boost may be supplied before being distributed to the house.

AUXILIARY ENERGY SYSTEM: Electric water heater. 30 gallon electric water heater provides total or partial heating as dictated by temperatures from the preheat tank.

DOMESTIC HOT WATER SYSTEM: Refer to collector, storage, and distribution for details.

COOLING: Not applicable.

PROJECT INFORMATION

BUILDER: City of Santa Clara

DESIGNERS **ARCHITECT**: Ditz-Crane

ENGINEER : Solar King

LOCATION: Santa Clara, CA Latitude 37°N.

HOUSING TYPE: Five Single Family Detached

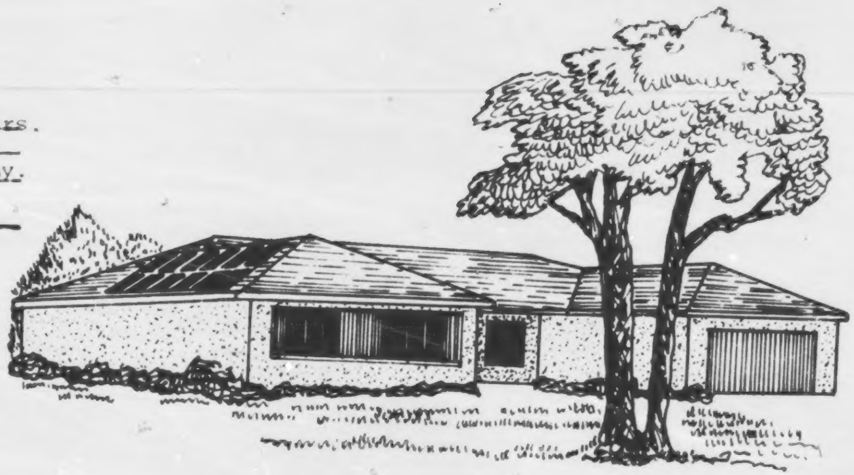
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,015 **COOLING** 150 hrs.

AVE. TEMP. **WINTER** 45 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 250 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project consists of five, single family detached dwellings each combined with a solar heating and domestic hot water preheating system. The two-story house design has a total of 2,000 square feet of heated floor area. The solar energy system will be owned by the public utility company and leased to the individual homeowner.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: Liquid-cooled flat-plate manufactured by Solar King, Inc. The size of the collector varies from 160 to 288 square feet.

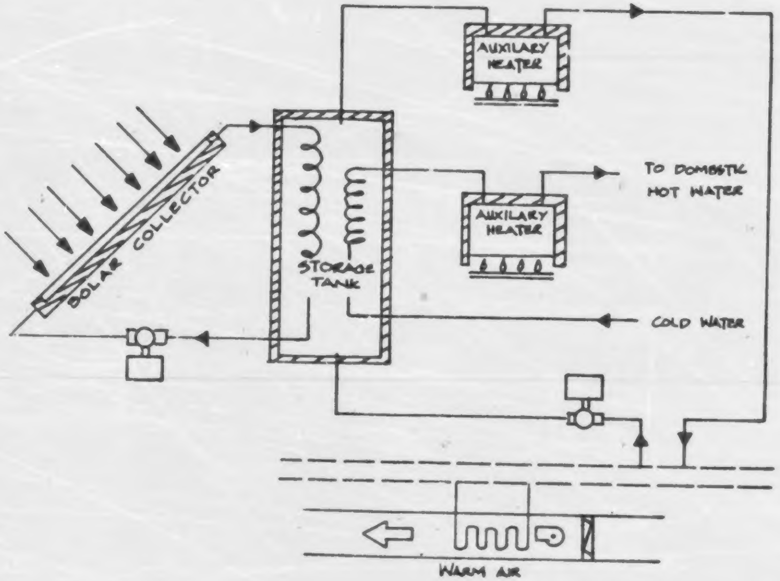
STORAGE: 1,500 gallons of water within an insulated steel tank located in the basement of each dwelling.

DISTRIBUTION: Forced air. Hot water from storage is pumped through a heating coil in the primary supply duct. A fan circulates air through the coil. The warmed air is then distributed by ducts to living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides total or supplemental heating as required.

DOMESTIC HOT WATER SYSTEM: Hot water from storage circulating through a copper immersion coil preheats the water in the conventional water heater's 70 gallon tank.

COOLING: Natural ventilation.



PROJECT INFORMATION

BUILDER: Self-Help Enterprises

DESIGNERS ARCHITECT: Octogon Associates

ENGINEER: Harold Hay & Philip Niles

LOCATION: Selma, California Latitude 37°N

HOUSING TYPE: Five Single Family Detached

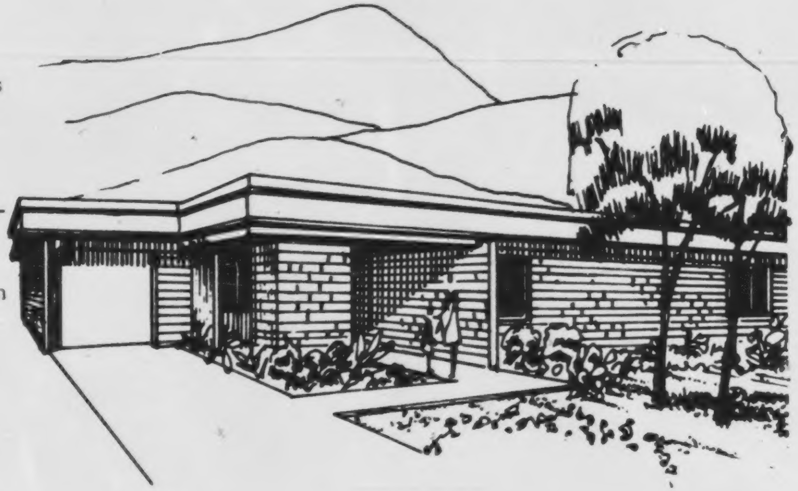
CLIMATIC DATA: DEGREE DAYS **HEATING** 2,619 **COOLING** 1,870 hrs

AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.

HORIZ. INSOLATION **JAN.** 260 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The projects consists of five one story single family dwellings each with 1,152 square feet of heated/cooled floor area. Water filled black plastic bags located within the flat roof structure provide passive solar energy collection and storage. The solar system supplies both heating and cooling. Exposure of the bags to solar radiation is controlled by movable insulated panels.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** ____

COLLECTOR: 960 square feet solar pond utilizing the patented "Skytherm" process. Movable insulated panels regulate solar exposure of the pond (water bags).

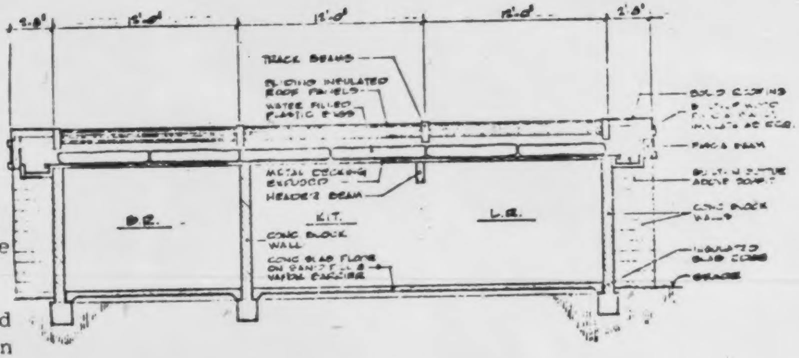
STORAGE: 660 cubic feet of water in black plastic bags located within the roof structure serves as the collector and storage element.

DISTRIBUTION: The water bags radiate captured heat through the corrugated steel roof to the living space. The insulating panels protect the living space from over-heating or cooling by appropriate covering or exposing of the bags

AUXILIARY ENERGY SYSTEM: A 5,000 watt electric resistance heater system and a 4.50 ton evaporative cooler back-up the same energy system.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is heated by a conventional electric water heater with the insulation panels closed.

COOLING: Water bags absorb heat from the house during the day. At night, the panels are opened and the absorbed heat is radiated to the cool night sky.


2'-0"
12'-0"
12'-0"
12'-0"
2'-0"
TRACK BEAMS
SLIDING INSULATED ROOF PANELS
WATER FILLED PLASTIC BAGS
METAL DECKING EXPOSED
HEADER BEAM
D.R.
KIT.
L.R.
CONC BLOCK WALL
CONC SLAB FLOOR ON SAND FILL & VAPOR BARRIER
FASCIA BEAM
BUILT-IN GUTTER ABOVE SOFFIT
CONC BLOCK WALL
INSULATED SLAB EDGE
GRADE

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PROJECT INFORMATION

BUILDER: Stonebreaker Investments

DESIGNERS **ARCHITECT:** Joint Venture Inc.

ENGINEER : Steelcraft Co.

LOCATION: Boulder, Colorado Latitude 40° N

HOUSING TYPE: Garden Apartments

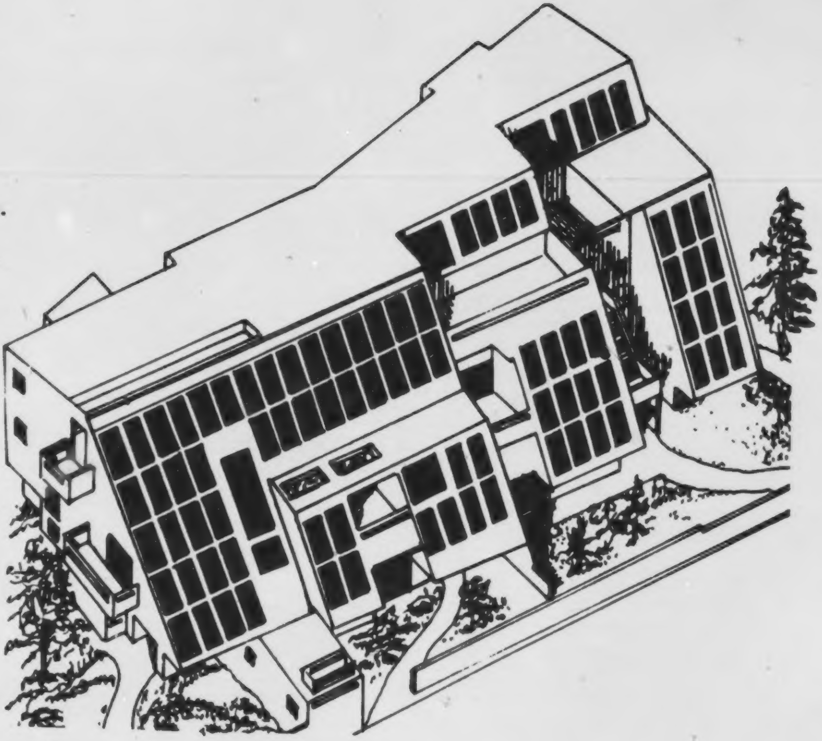
CLIMATIC DATA: DEGREE DAYS **HEATING** 6,285 **COOLING** 630 hrs.

AVE. TEMP. **WINTER** 15 **SUMMER** 55° F.

HORIZ. INSOLATION **JAN.** 201 **JUNE** 525 Ly.

BUILDING DESCRIPTION

The project consists of eight units of student housing totalling 8,479 square feet within a four story building. The wood frame building form is compact. Thus, minimizing exterior exposure. Airlock vestibules aid the maintenance of a stable interior thermal environment. The north side of the building uses trees and minimal fenestration for protection from prevailing winds, while the south side has large openings for solar heat gain in winter but overhangs for summer shading.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 860 square feet liquid-cooled compound parabolic concentrating collectors manufactured by Steelcraft Corp.

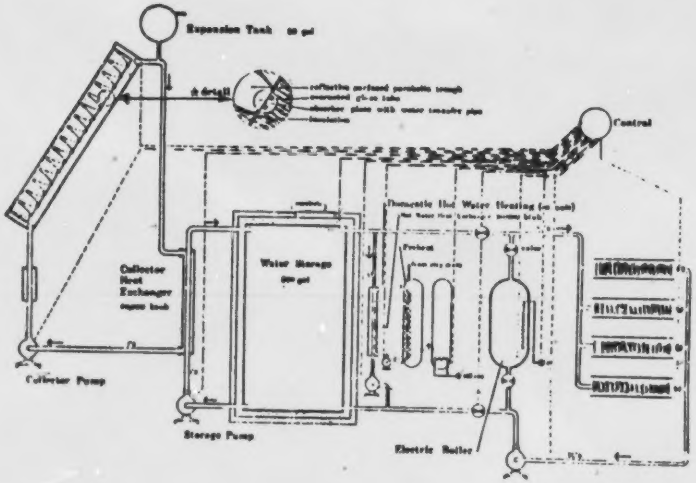
STORAGE: 1,720 gallon tank of de-ionized water and corrosion inhibitor, with heat exchanger between collector and storage tank to heat stored water.

DISTRIBUTION: Centrifugal pumps are used with baseboard convectors. Shell and tube single pass, counter flow heat exchangers are used. Each unit has 87 feet of baseboard convectors supplied by either solar or auxiliary energy.

AUXILIARY ENERGY SYSTEM: 16 kilowatt electric boilers and water heaters on-line with solar distribution system.

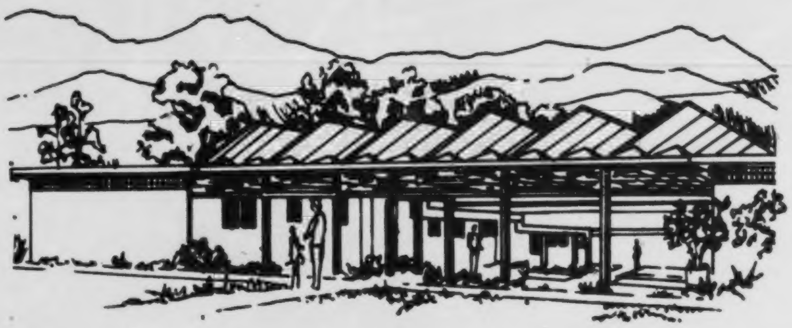
DOMESTIC HOT WATER SYSTEM: Domestic hot water supply is preheated by a heat coil passing through the separate storage tank.

COOLING: Natural ventilation.


Expansion Tank
detail
evacuated glass tube
insulation
Control
Domestic Hot Water Heating
Preheat
Collector Heat Exchanger
Water Storage
Collector Pump
Storage Pump
Electric Boiler

PROJECT INFORMATION

BUILDER: City of Colorado Springs
DESIGNERS ARCHITECT: City of Colorado Springs
ENGINEER: None designated
LOCATION: Colorado Springs, Colorado Latitude 39° 30'
HOUSING TYPE: Two Six-Plex Row Units
CLIMATIC DATA: DEGREE DAYS HEATING 6,423 **COOLING** 350 hrs.
AVE. TEMP. WINTER 15 **SUMMER** 55°F.
HORIZ. INSOLATION JAN. 250 **JUNE** 650 Ly.



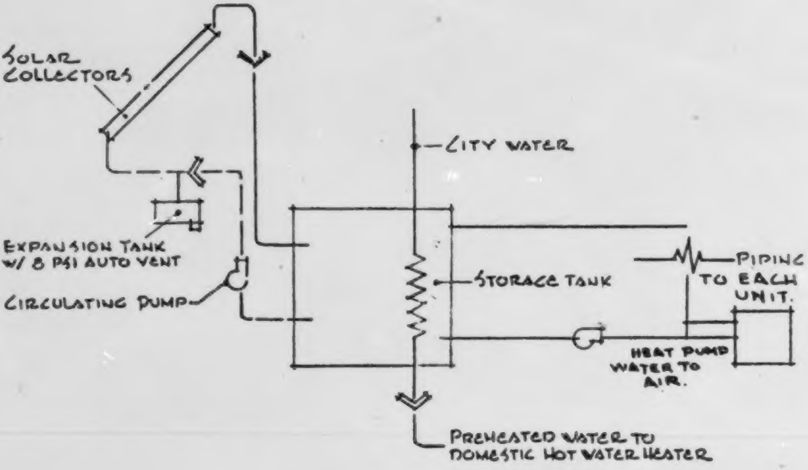
BUILDING DESCRIPTION

The project involves the redesign of a complex of one story dwelling units for solar domestic hot water heating. The solar energy system will serve 12 living units. The solar collectors are not integrated with the buildings. The collectors are placed on a structural frame spanning between the two six-unit buildings, thus forming a shaded courtyard. Heating and cooling is also provided for by solar energy.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** X **DHW** X

COLLECTOR: 1,500 square feet of liquid-cooled all-glass vacuum tube type collectors manufactured by Owens-Illinois



STORAGE: 1,200 gallons of water within an insulated 9' x 25' buried tank.

DISTRIBUTION: Forced air with heat pump. Heated water from storage circulates through a heat exchanger in the heat pump. A fan in the heat pump blows air past the hot coil picking up heat for the living space.

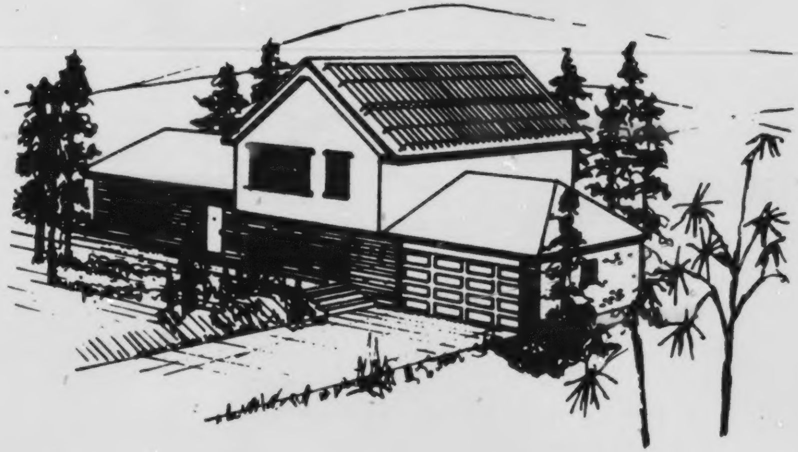
AUXILIARY ENERGY SYSTEM: Gas furnace. Existing furnaces heat a coil in the same ductwork used by the solar distribution system.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by running the supply line through a heat exchanger located in the solar storage tank. Preheated water is placed in the existing 750 gallon storage tank or a conventional water heater prior to distribution to each apart.

COOLING: Heat pump utilizing solar storage as a heat sink; natural ventilation.

PROJECT INFORMATION

BUILDER: Perl-Mack Co.
DESIGNERS **ARCHITECT:** Robert Keener
ENGINEER: John Tuttle
LOCATION: Denver, CO Latitude 40°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 5,839 **COOLING** 1,411 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 60°F.
HORIZ. INSOLATION **JAN.** 525 **JUNE** 200 Ly.



BUILDING DESCRIPTION

The project involves the application of solar heating, cooling, and domestic hot water heating to a 2,229 square foot, two-story residence. Wall, floor and ceiling insulation is increased to reduce heat losses. The solar collectors are mounted on the south-sloping roof of the house.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 576 square foot liquid-cooled all-glass vacuum tube type collectors manufactured by Owens-Illinois. The inner absorber tube is coated with a selective surface for improved solar collection.

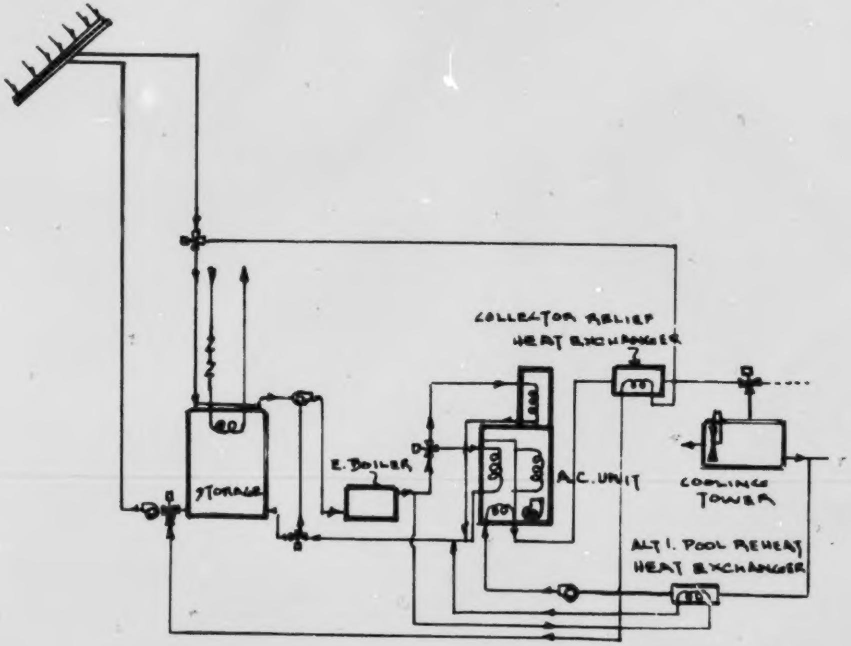
STORAGE: 1,500 gallons of water within an insulated cylindrical storage tank located in the basement.

DISTRIBUTION: Forced air. Hot water from storage flows through heat coils in the primary supply duct. The heat pump fan circulates air over the coils warming the air that is distributed by duct to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electric boiler. The boiler provides heated water to the electrically driven heat pump used in off peak hours.

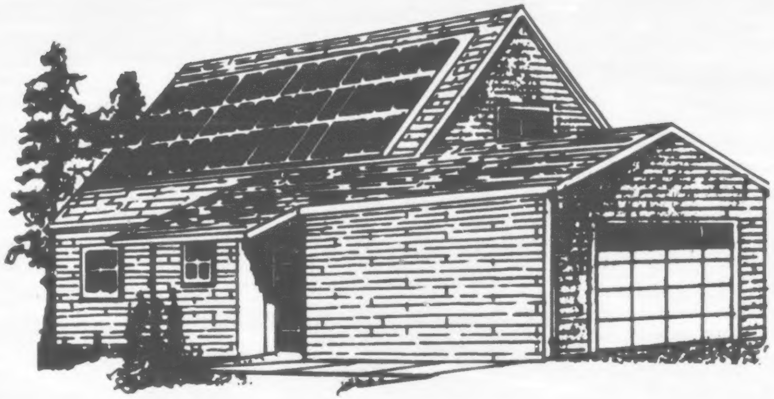
DOMESTIC HOT WATER SYSTEM: A shell in tube heat exchanger in main storage tank preheats water prior to entering a 124 gallon electric domestic water heater.

COOLING: Solar heated water is used to power an absorption cycle cooling unit that supplies cooled water to individual fan coil units.



PROJECT INFORMATION

BUILDER: Eco-Era Incorporated
DESIGNERS ARCHITECT: Dr. C. Byron Winn & Les Shaw
ENGINEER : Russel M. Miller
LOCATION: Fort Co.lins, Colorado Latitude 40.7°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 6,200 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 15 **SUMMER** 55°F.
HORIZ. INSOLATION **JAN.** 210 **JUNE** 660 Ly.



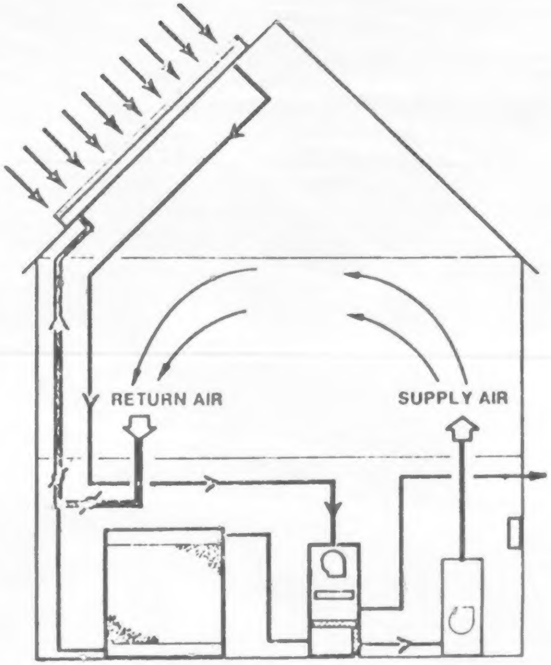
BUILDING DESCRIPTION

The project is a 1,760 square foot two story single family residence incorporating a solar heating and domestic hot water preheating system. The building utilized wood frame construction with a concrete foundation and wood shingled exterior walls. Added wall and roof insulation, smaller window area, and insulated shutters reduce the dwelling's energy requirement and improve the solar system's performance. The solar collectors are integrated with the roof structure and the storage bin is located in the unfinished basement.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 312 square foot air-cooled flat-plate manufactured by Solaron Corporation.



STORAGE: 394 cubic feet of one and one-half inch diameter rock within a 7'6" x 7'6" x 7'0" storage bin located in the basement.

DISTRIBUTION: Forced air. Heated air from the collectors passes directly into the living spaces or the storage bin, or is vented to the outside. Distribution from storage is accomplished by a blower and ducts.

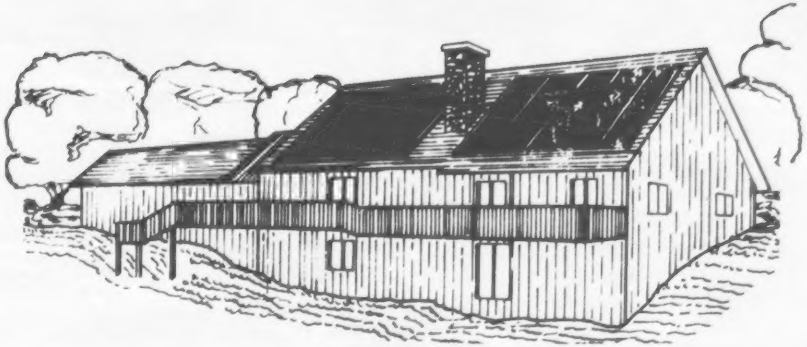
AUXILIARY ENERGY SYSTEM: Electric heat pump arranged in-line with the collectors, storage, and distribution, the heat pump provides a full or partial energy boost.

DOMESTIC HOT WATER SYSTEM: Preheated by a finned coil heat exchanger located in the primary distribution duct of the central air handling unit. Storage and auxiliary heating is provided by a conventional water heater.

COOLING: Electric heat pump, natural ventilation. Cooling by air to air heat pump is not solar assisted.

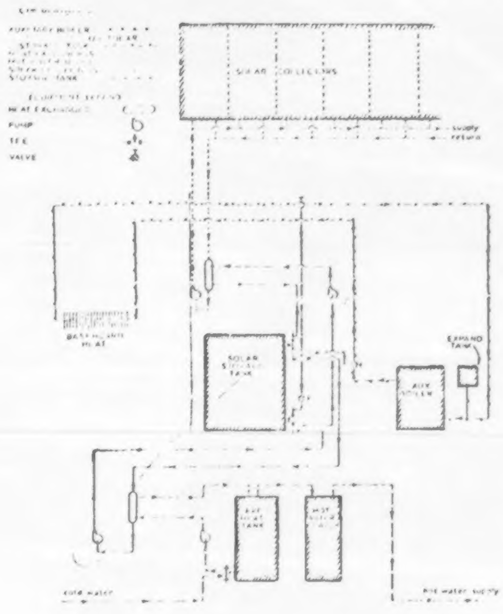
PROJECT INFORMATION

BUILDER: Solar Environmental Engineering Const. Co.
DESIGNERS ARCHITECT: Dr. C. Byron Winn
ENGINEER: SECO
LOCATION: Fort Collins, CO Latitude 40° 40'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 6,200 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 525 Ly.



BUILDING DESCRIPTION

The project consists of a two-story, 2,352 square foot single family detached dwelling with a solar heating and domestic hot water preheating system. Window openings have been minimized to reduce heat gains and extra insulation added to walls, roof and ceiling to reduce heat losses. The chimney is centrally located in the home to maximize the amount of radiant heat available to occupied areas. The exterior walls are covered with cedar siding, while cedar shakes protect the roof.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X
COLLECTOR: 672 square feet liquid-cooled flat-plate manufactured by Reynolds.

STORAGE: 1,245 gallons of water and corrosion inhibitor within an insulated 11' diameter x 7' storage tank. A separate 75 gallon preheat tank supplies the domestic hot water system.

DISTRIBUTION: Hydronic. A heat exchanger transfers heat between the collector loop and the solar storage tank. Water from storage either goes directly to a baseboard heater or if it needs supplemental heat is passed through the boiler.

AUXILIARY ENERGY SYSTEM: Electric boiler. The boiler in-line between storage and baseboard heaters provides auxiliary heating.

DOMESTIC HOT WATER SYSTEM: Domestic hot water supply line passes through the preheat water prior to entering a conventional 100 gallon water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: City of Pueblo, Colorado
DESIGNERS **ARCHITECT:** not designated
ENGINEER: Hurtig, Gardner & Froelich
LOCATION: Pueblo, Colorado Latitude 38° N
HOUSING TYPE: Five Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 5,400 **COOLING** 900 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 60°F.
HORIZ. INSOLATION **JAN.** 240 **JUNE** 630 Ly.

BUILDING DESCRIPTION

The project involves the application of a central solar domestic hot water heating system to five existing single family dwellings. A centrally located detached unit houses the solar collectors, heat storage tank, and necessary pumps and valves. The unit is connected by insulated pipes to the domestic hot water heaters of the five houses. Chicken wire covers the glass collection surfaces for protection from vandalism.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 144 square feet liquid-cooled flat-plate manufactured by RAYPAK Inc. The system employs an automatic drain down for freeze protection. One-half the collector array is fitted for maximum summer efficiency while the other half is fitted for maximum winter efficiency.

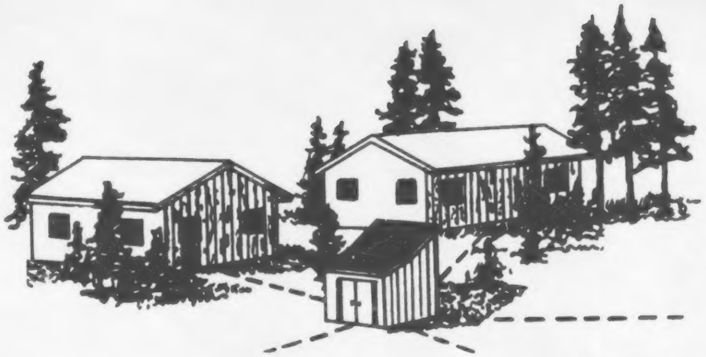
STORAGE: 350 gallons of water stored within a glass lined steel tank. The water circulated through the collectors is pumped to storage and then to the dwellings for distribution and possibly an energy boost.

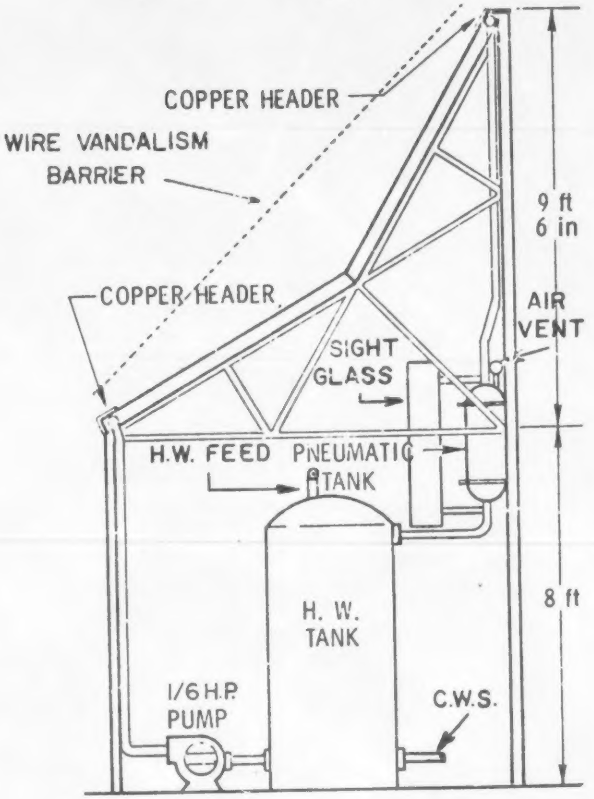
DISTRIBUTION: Underground insulated pipes connect the central collection and storage unit to the conventional water heaters located in each house.

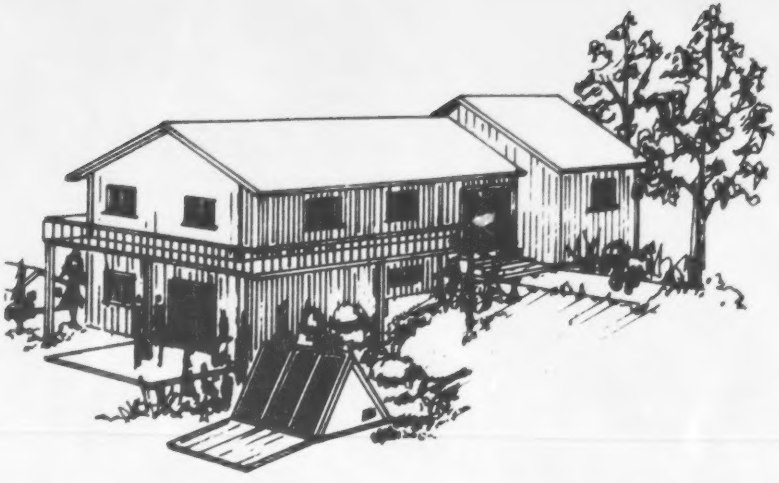
AUXILIARY ENERGY SYSTEM: Gas-fired hot water heater. The existing water heaters are used for individual dwelling hot water storage and for supplying energy boost.

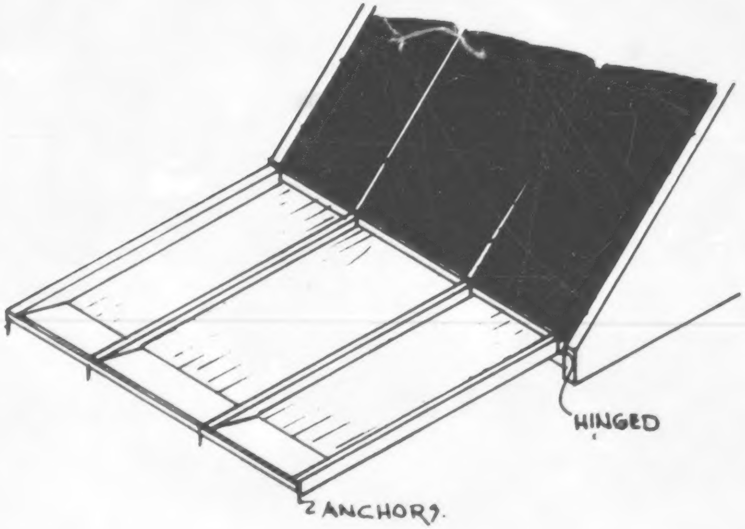
DOMESTIC HOT WATER SYSTEM: The solar energy system is for domestic water hot water heating only. For description of system components, see collector, storage, and distribution above.

COOLING: Not applicable.









PROJECT INFORMATION

BUILDER: Waverly Homes Inc.
DESIGNERS **ARCHITECT:** Robert Jensen
ENGINEER: Sunglow Inc.
LOCATION: Westminster, Colorado Latutide 39°49'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 6,016 **COOLING** 630 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines a 946 square foot, two story contemporary ranch house with a solar space heating system. The solar collector is housed in a separately detached structure adjacent to the dwelling. Energy conserving features include 2" x 6" studs used for exterior walls spaced 24" on center allowing for thicker insulation. A continuous soffit vent provides more efficient attic ventilation. Window area is reduced to 9 percent of the exterior surface area. These modifications and others reduce the dwelling's heat loss and improve the thermal performance of the solar energy system.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** ____

COLLECTOR: 96 square foot air-cooled flat-plate manufactured by Sunglow. The collector is oriented 5° west of south.

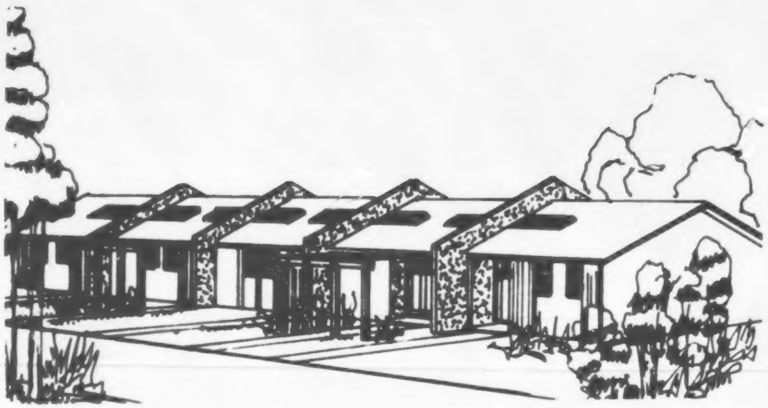
STORAGE: 13 tons of 3/4" to 1 1/4" diameter river rock within an insulated bin located behind the "A" frame collector.

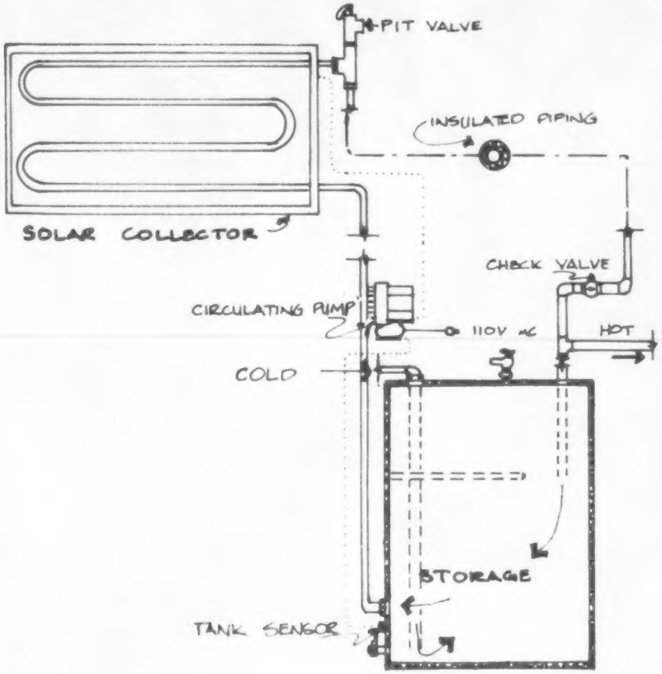
DISTRIBUTION: Forced air. A fan blows air through the rock storage bin warming the air for distribution throughout the house by ducts. Warm air is also blown out of a heat circulating fireplace..

AUXILIARY ENERGY SYSTEM: A fireplace and an electric resistance coil in the ductwork supplement the solar energy system as required.

DOMESTIC HOT WATER SYSTEM: Conventional domestic hot water heating system.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: Babcock Company
DESIGNERS ARCHITECT: Christ Fergis
ENGINEER : Schebke-Shiskin & Associates
LOCATION: Coral Gables, Florida Latitude 25°45'N.
HOUSING TYPE: Single Family Attached
CLIMATIC DATA: DEGREE DAYS **HEATING** 200 **COOLING** 2,400 hrs.
AVE. TEMP. **WINTER** 65 **SUMMER** 80°F
HORIZ. INSOLATION **JAN.** 350 **JUNE** 540 Ly

BUILDING DESCRIPTION

The project involves adding a solar domestic hot water system to a conventional five unit single family attached dwelling design. The 997 square feet of living space per unit are housed within a concrete masonry structure with a low-pitched reflecting glass, extra insulation, attic ventilation along horizontal soffit areas, a 12" turbine ventilator near the roof ridge, and careful caulking to reduce infiltration losses at all wall penetrations. The solar collectors are located on the sloping south-facing roof of each housing unit.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 24 square feet per apartment liquid-cooled flat-plate manufactured by Capital Solar Heating. Below a double strength glass cover plate is an absorber made of copper tubing and galvanized metal.

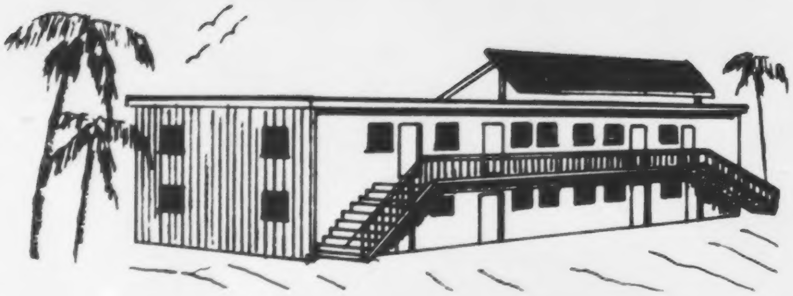
STORAGE: The tank of a conventional water heater is used to store solar heated water from the collector.

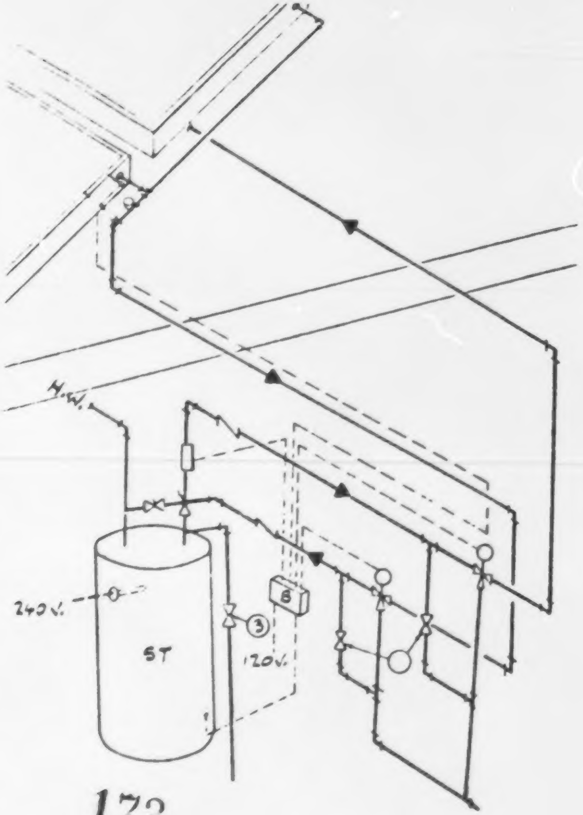
DISTRIBUTION: Since solar heated water is stored within a conventional water heater distribution is the same as the conventional system.

AUXILIARY ENERGY SYSTEM: Conventional water heater. Solar heated water stored in tank is raised to a useful temperature, if necessary, by a conventional water heater.

DOMESTIC HOT WATER SYSTEM: See collector, storage and distribution for details.

COOLING: Not applicable.





PROJECT INFORMATION

BUILDER: City of St. Petersburg
DESIGNERS ARCHITECT: Reynolds, Smith & Hills
ENGINEER: Energy Design Associates
LOCATION: St. Petersburg, Florida Latitude 28°N
HOUSING TYPE: Low-Rise Multi-Family
CLIMATIC DATA: DEGREE DAYS HEATING 683 **COOLING** 2,000 hrs.
AVE. TEMP. WINTER 65 **SUMMER** 85°F.
HORIZ. INSOLATION JAN. 400 **JUNE** 530 Ly.

BUILDING DESCRIPTION

The projects involves the integration of a solar domestic hot water system into an existing two story apartment building. The solar collectors are roof-mounted on a steel structural frame secured to the existing roof. Piping from the collectors passes through the building to four shared storage tanks - two on each floor. Each storage tank serves two apartments.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING____ **COOLING**____ **DHW** x

COLLECTOR: 144 square foot liquid-cooled flat-plate manufactured by Gulf Thermal Corporation with an automatic drain down system for freeze protection.

STORAGE: Four 80 gallon insulated storage tanks service eight apartments. A heat exchanger is not used. The water is distributed directly to the dwelling from collector through storage.

DISTRIBUTION: Distribution of solar heated domestic hot water is by the existing piping network. The piping between the collector and the conventional water heater storage tank are insulated to reduce heat loss.

AUXILIARY ENERGY SYSTEM: Existing electric water heaters provide auxiliary energy should the solar system produce insufficient temperatures or become inoperable.

DOMESTIC HOT WATER SYSTEM: The solar energy system is for domestic hot water heating only. For description of system components see collector, storage and distribution above.

COOLING: Not applicable.

PROJECT INFORMATION

BUILDER: Hooker-Barnes

DESIGNERS ARCHITECT: Karl Kelley

ENGINEER: Karl Kelley

LOCATION: Atlanta, GA Latitude 33,7°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: DEGREE DAYS **HEATING** 2,983 **COOLING** 750 hrs.

AVE. TEMP. **WINTER** 45 **SUMMER** 75°F.

HORIZ. INSOLATION **JAN.** 210 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project combines a "colonial-styled" single family dwelling with a solar heating and domestic water preheating system. The design is a standard 1,622 square foot plan with two floors and a basement that has been modified to reduce heat losses by half. Foil-backed sheetrock, a higher grade and thickness of insulation in ceilings and walls, floor insulation where normally there is none, storm windows, and double-paned glass achieve these savings. The solar collectors are mounted on the sloping south-facing roof of the dwelling and the garage.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ___ **DHW** X

COLLECTOR: 600 square foot liquid-cooled flat-plate manufactured by Revere.

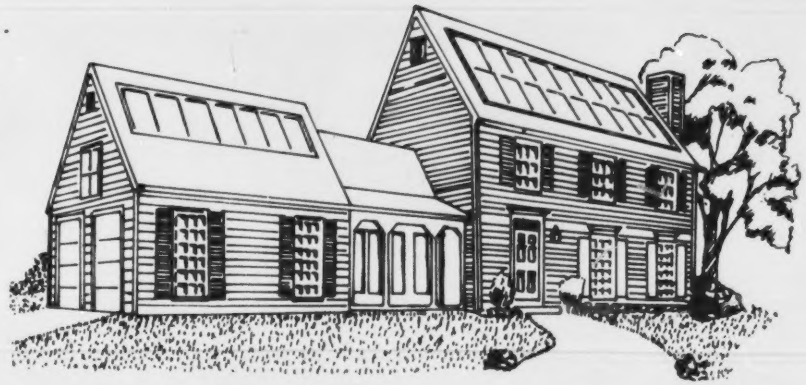
STORAGE: 2,000 gallons of water within a tank located in the basement. The tank is sized for a three to four day storage capacity.

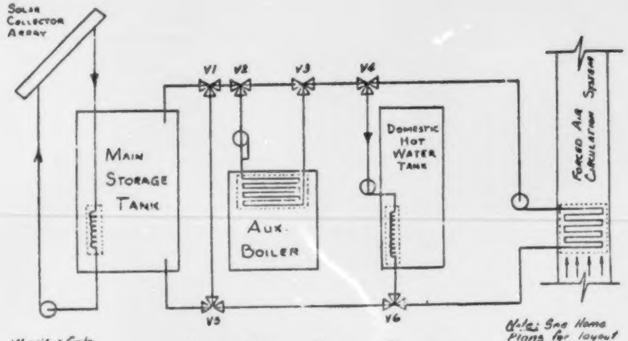
DISTRIBUTION: Forced air. Heated water from the heat storage tank passes through coils in the primary supply duct. Air is blown past the heated coils and distributed to the living spaces by ducts.

AUXILIARY ENERGY SYSTEM: Gas-fired boiler. Water within the boiler is preheated by water for heat storage circulating through a heat exchanger within the boiler tank.

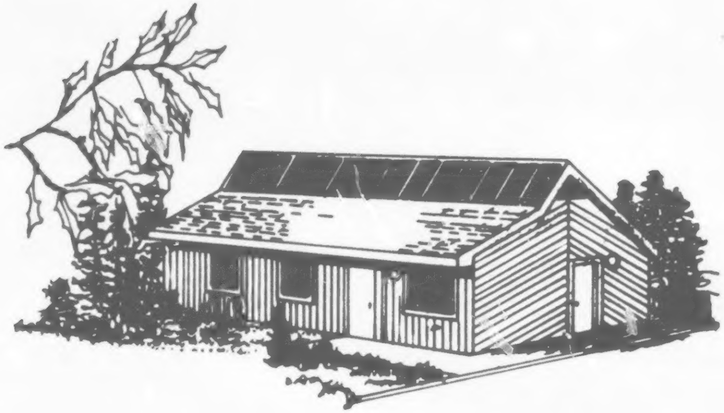
DOMESTIC HOT WATER SYSTEM: Hot water from storage preheats a 120 gallon conventional water heater through a copper heat exchanger.

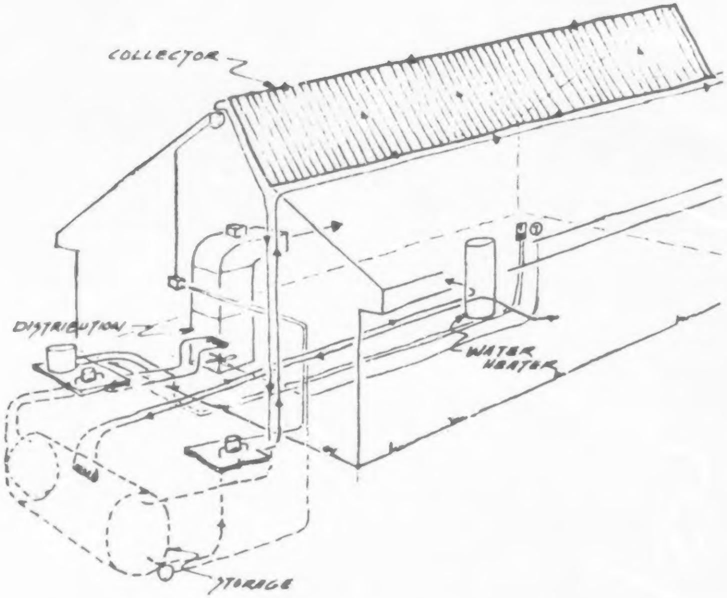
COOLING: Natural ventilation.




Solar Collector Array
V1
V2
V3
V4
V5
V6
Main Storage Tank
Aux. Boiler
Domestic Hot Water Tank
Forced Air Circulation System
V1 - V6 = Gate Valves
Note: See Home Plans for layout of system within the home.

Solar Energy System Schematic





PROJECT INFORMATION

BUILDER: Winford Lindsay

DESIGNERS **ARCHITECT:** Winford Lindsay

ENGINEER : Independent Living, Inc.

LOCATION: Dacula, Georgia Latitude 35°N

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 3,095 **COOLING** 1,500 hrs.

AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.

HORIZ. INSOLATION **JAN.** 230 **JUNE** 570 Ly.

BUILDING DESCRIPTION

The project is a one story wood frame house with 1,000 square feet of heated floor area. The single family dwelling is designed for simple low-cost construction in rural areas. The number of window openings is held to a minimum to reduce heat losses; and their location is governed by the ability to control solar heat gain. As a result, the majority of windows are located on the south side of the house with an extended roof overhang to block to hot summer sun. The design includes a solar heating and domestic hot water preheating system. The solar collectors are integrated with the roof structure.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 250 Square foot liquid-cooled flat-plate manufactured by Revere Copper and Brass with an automatic drain down for freeze protection, south-facing windows.

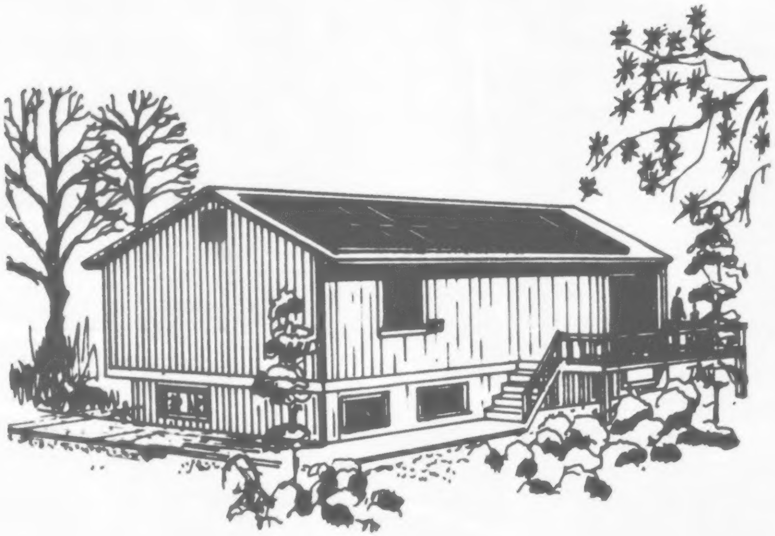
STORAGE: 500 gallons of water within an insulated steel tank buried adjacent to the building. Water from the tank is circulated through the collectors to capture solar energy.

DISTRIBUTION: Forced air. Heated water from the storage tank is pumped to a heat exchanger within fan coil unit for distribution by ducts throughout the house.

AUXILIARY ENERGY SYSTEM: Electric resistance heating coil located in primary supply duct.

DOMESTIC HOT WATER SYSTEM: A water to water heat exchanger located in the central storage tank preheats the domestic hot water supply prior to passage through a conventional water heater.

COOLING: Natural ventilation.



PROJECT INFORMATION

BUILDER: Peachtree Homes Inc.

DESIGNERS ARCHITECT: Denney Associates
ENGINEER: Independent Living Inc.

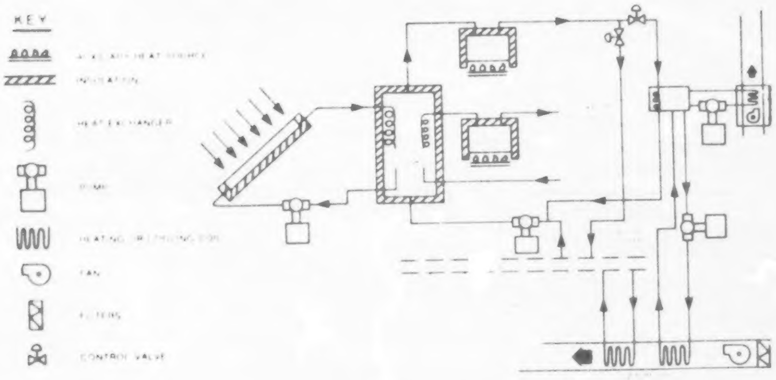
LOCATION: Shenandoah, Georgia Latitude 33°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: DEGREE DAYS **HEATING** 3,095 **COOLING** 1,589 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 230 **JUNE** 570 Ly.

BUILDING DESCRIPTION

The project combines a 1,216 square foot single family detached dwelling with a solar heating, cooling, and domestic hot water preheating system. Heat losses are reduced by added wall, floor, and ceiling insulation. 2"x6" at 24" o.c. wall studs are used to allow for the added insulation. Also, the dwelling's window area is decreased to reduce heat losses.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 273 square foot liquid-cooled flat-plate manufactured by Revere. The multiple 3'x6x collector panels form an integrated roof system.

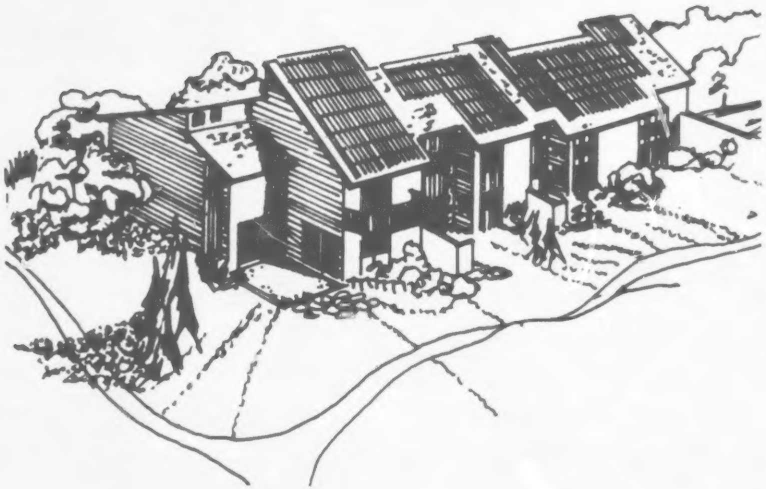
STORAGE: 2,000 gallons of water within an insulated welded steel tank located in the basement. A heat exchanger is used to transfer capture heat from the collector to the storage tank.

DISTRIBUTION: Forced air. Hot water is pumped from storage to a fan coil unit in the ductwork. Air is circulated through the coils, heated and distributed by duct to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired heat pump. The heat pump provides total or supplemental hot water to the fan coil as required.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated as it passes through a heat exchanger located in the heat storage tank en route to an oversized conventional water heater.

COOLING: Cooling is achieved by circulating solar heated water through an Arkla absorption chiller. The cool water is pumped to the fan coil units for forced air distribution.

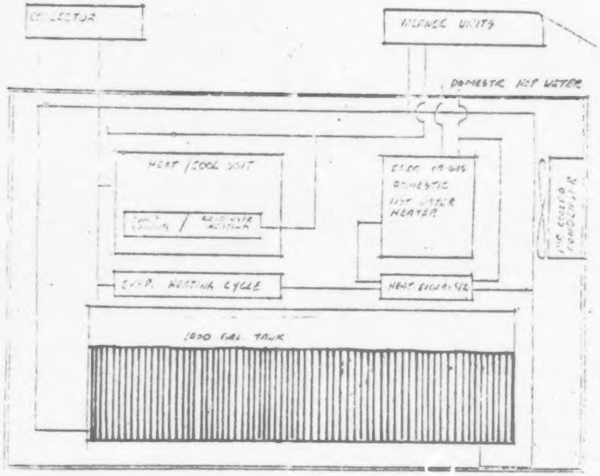


PROJECT INFORMATION

BUILDER: United Development Co.
DESIGNERS ARCHITECT: ECOSOL Ltd.
ENGINEER: United Developmental Co.
LOCATION: Vernon Hills, Illinois Latitude 42°17'N.
HOUSING TYPE: Four - Single Family Attached
CLIMATIC DATA: DEGREE DAYS HEATING 6,639 **COOLING** 1,550 hrs.
AVE. TEMP. WINTER 25 **SUMMER** 70° F.
HORIZ. INSOLATION JAN. 170 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines heating and domestic hot water preheating system with four, two story, single family attached dwellings. Each dwelling totals 3,300 square feet of heated floor area. The wood frame building displays contemporary styling and simple details. Collectors are mounted on the sloping south-facing roof. Benefits of attached units are a reduction of heat losses and a decrease in solar system size.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** X **DHW** X

COLLECTOR: 1,250 square feet liquid-cooled evacuated glass tube module. Three concentric tubes: transparent cover, absorber with selective coating, and a feeder tube comprise each module.

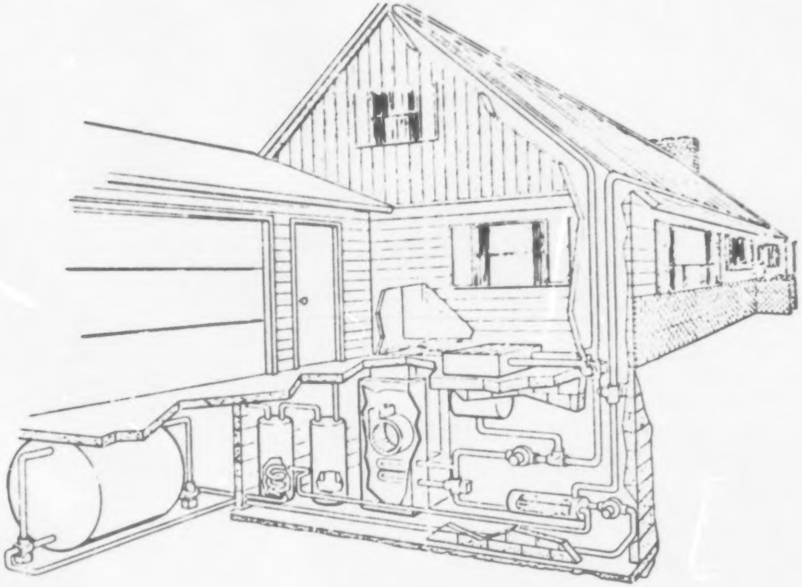
STORAGE: 1,000 gallons of water within an insulated tank located in the basement.

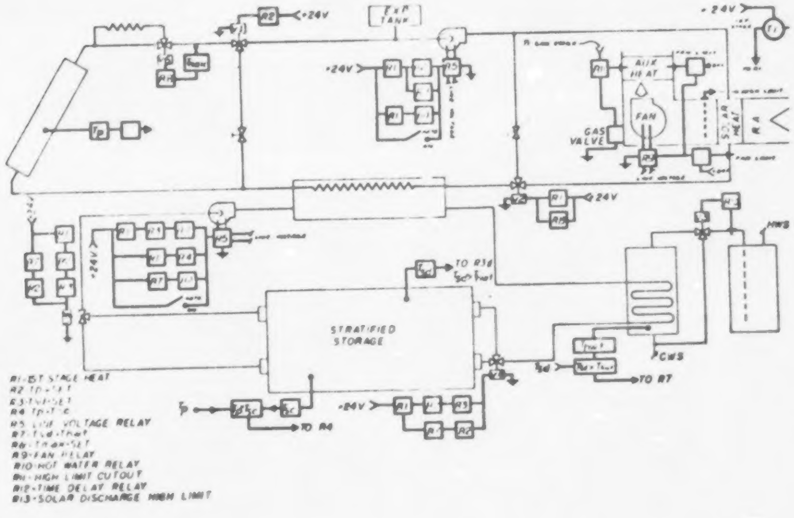
DISTRIBUTION: Hydronic. Heated water from storage is pumped directly to valance heating units in occupied areas. When storage temperatures are insufficient the heat pump and domestic water heater provide supplemental energy.

AUXILIARY ENERGY SYSTEM: A gas-fired heat pump elevates storage temperatures prior to pumping the heated liquid to valance units.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by passing the supply line through a copper shell and coil type heat exchanger in the main storage. The preheated water is stored in the tank of a conventional 185 gallon heater.

COOLING: Natural ventilation.




+24V
EXP TANK
AUX HEAT
FAN
GAS VALVE
STRATIFIED STORAGE
HWS
CWS
TO R7
TO R4
R1-1ST STAGE HEAT
R5 LINE VOLTAGE RELAY
R9-FAN RELAY
R10-HOT WATER RELAY
R11-HIGH LIMIT CUTOUT
R12-TIME DELAY RELAY
R13-SOLAR DISCHARGE HIGH LIMIT

PROJECT INFORMATION

BUILDER: Marvin Anderson Co.
DESIGNERS **ARCHITECT:** Marlin Grant
ENGINEER: Honeywell Inc.
LOCATION: Bloomington, MN Latitude 45°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 8,382 **COOLING** 500 hrs.
AVE. TEMP. **WINTER** 10 **SUMMER** 65°F.
HORIZ. INSOLATION **JAN.** 170 **JUNE** 535 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating and domestic hot water preheating system to a single family detached dwelling. The wood frame two-story house has 1,215 square feet of heated floor area. Collectors are mounted on the steep south-sloping roof. Heat loss is reduced by the addition of more insulation in the walls, floors, and ceiling.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ___ **DHW** X

COLLECTOR: 378 square feet liquid-cooled flat-plate manufactured by Lennox Industries.

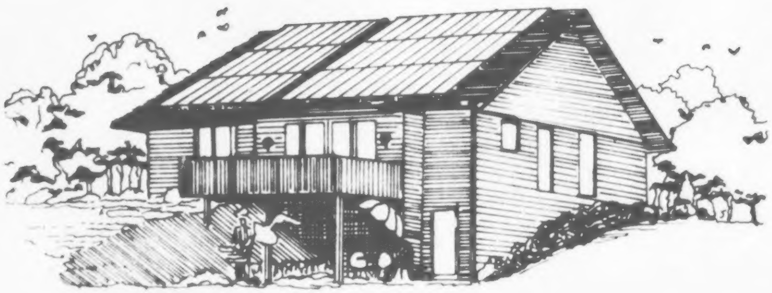
STORAGE: 1,000 gallons of liquid within an insulated fiberglass tank located in the basement. Heat removed from the collectors passes through a heat exchange in the storage tank.

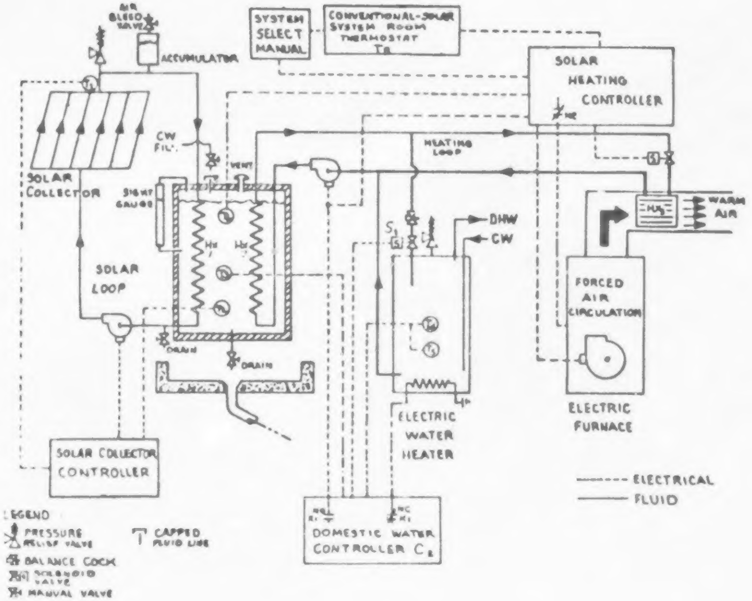
DISTRIBUTION: Forced air. A heating coil in the primary supply duct warms air circulated past the coil for distribution by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides total or supplemental energy to a heat exchanger in the ductwork placed after the fan.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated in a 64 gallon stone-lined tank. Heated water from storage circulating through a finned copper heating coil. The preheat tanks supplies a 50 gallon conventional water heater.

COOLING: Natural ventilation.




AIR BLEED VALVE
ACCUMULATOR
SYSTEM SELECT MANUAL
CONVENTIONAL-SOLAR SYSTEM ROOM THERMOSTAT T_R
SOLAR HEATING CONTROLLER
CW FIL.
VENT
HEATING LOOP
SOLAR COLLECTOR
SIGHT GAUGE
H_{X1}
H_{X2}
S_1
DHW
CW
WARM AIR
HX_3
SOLAR LOOP
FORCED AIR CIRCULATION
DRAIN
DRAIN
ELECTRIC WATER HEATER
ELECTRIC FURNACE
SOLAR COLLECTOR CONTROLLER
ELECTRICAL
FLUID
DOMESTIC WATER CONTROLLER C_2
LEGEND
PRESSURE RELIEF VALVE
CAPPED FLUID LINE
BALANCE COCK
SOLENOID VALVE
MANUAL VALVE

PROJECT INFORMATION

BUILDER: The Kelly Fischer Company
DESIGNERS ARCHITECT: David Baumgartner
ENGINEER: Not Designated
LOCATION: St. Louis, Missouri Latitude 38°N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,895 **COOLING** 1,150 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 170 **JUNE** 540 Ly.

BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with a contemporary split-level single family dwelling design. The wood house has 2,120 square feet of heated floor area under a double pitched roof. The south sloping roof has sufficient area for solar collectors to provide a major percentage of the dwelling's heating requirement. Large south-facing windows allow additional solar radiation to heat the house during the winter months but an extended roof overhang blocks summer sun penetration.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 912 square foot liquid-cooled flat-plate manufactured by Revere Copper and Brass, Inc. The collectors are roof mounted and utilize a water-glycol solution for heat transfer and freeze protection.

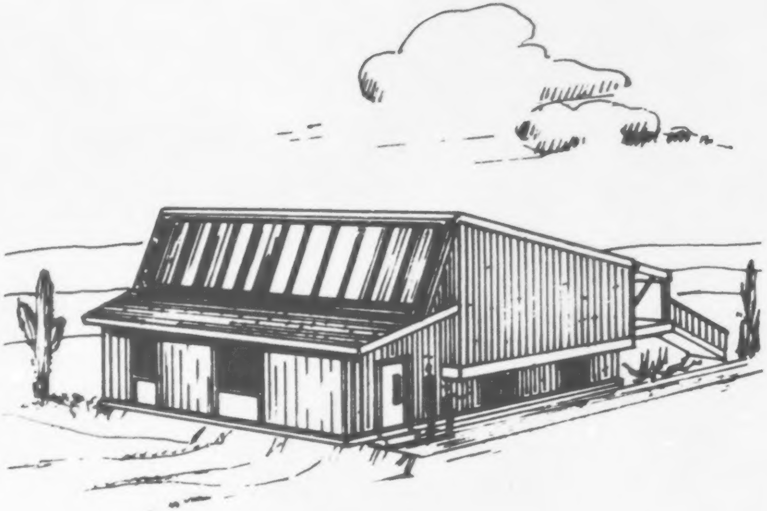
STORAGE: 1,000 gallons of water within an insulated storage tank. Heat is transfered from the collectors to the tank by way of a water to water heat exchanger.

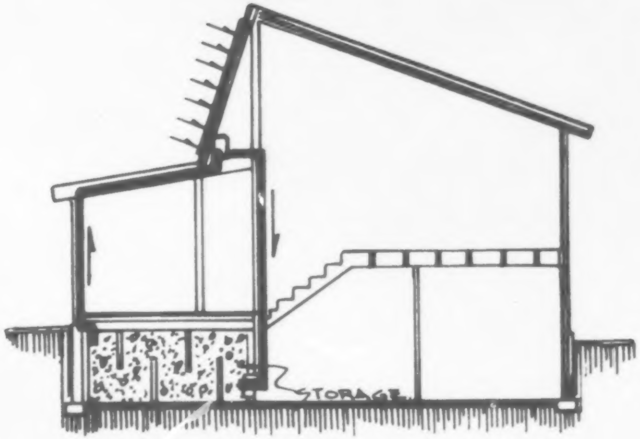
DISTRIBUTION: Forced air, natural radiation and convection. A heat transfer loop between the storage tank and a heat coil located in the primary supply duct provides heat for distribution by secondary supply ducts to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electric resistance furnace. Integrated with the solar distribution system, the furnace provides full or partial heating as required.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated by running a heat transfer loop from storage to a heat exchanger located in the conventional water heater.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: The Blackfeet Tribe
DESIGNERS ARCHITECT: W.C. Bierrum
ENGINEER: Archambault & Co.
LOCATION: Blackfeet Indian Reservation, MT Lat. 48°30'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 8,700 **COOLING** 250 hrs.
AVE. TEMP. WINTER 15 **SUMMER** 65°F.
HORIZ. INSOLATION JAN. 150 **JUNE** 600 Ly.

BUILDING DESCRIPTION

As part of a larger program sponsored by HUD for self-help housing for the Blackfeet Tribe, five single family detached dwellings are combined with a solar heating and domestic hot water preheating system. The two-story homes total 1,226 square feet of heated floor area. Simply styled, the contemporary homes are sheathed by wood on a wood frame. The collectors are mounted on the steeply pitched south-facing roof.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 192 square feet air-cooled flat-plate manufactured by Solar-Aire Inc. A blackened aluminum sheet with attached aluminum cups and baffles lies below two layers of fiberglass cover plates.

STORAGE: 746 cubic feet of rock within an insulated storage bin located in the basement. Partial separations in the storage bin prevent temperature stratification.

DISTRIBUTION: Forced air. The fan of an electric furnace circulates heated air from the collector to the storage bin. Storage radiates this heat directly to living spaces. Direct supply from collectors is sometimes fed into the return air of the furnace.

AUXILIARY ENERGY SYSTEM: Electric furnace. The furnace and a thermostatically controlled wood stove supplement the solar heating system.

DOMESTIC HOT WATER SYSTEM: A preheat coil embedded within the rock storage bin preheats the domestic hot water supply prior to passage through a conventional water heater.

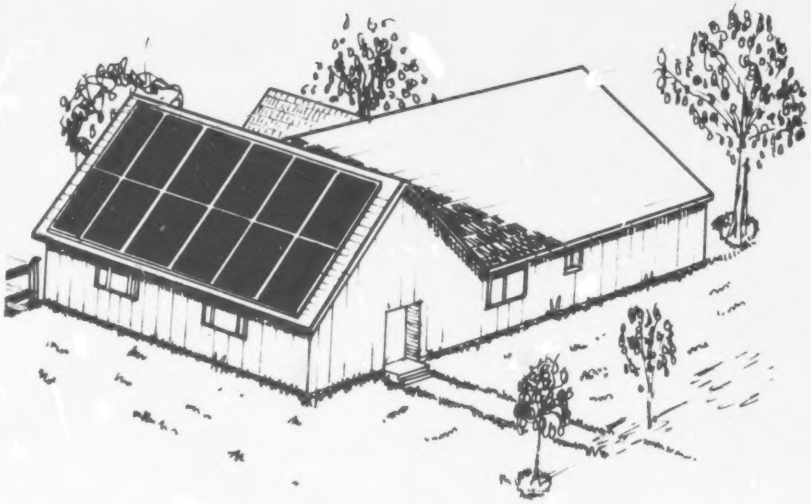
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Korman Corporation
DESIGNERS **ARCHITECT:** Richard G. Guenzel
ENGINEER: Bennett Levin
LOCATION: Blackwood, NJ Latitude 39° 53'N.
HOUSING TYPE: Two Single Family Detached
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,101 **COOLING** 150 hrs
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 530 Ly.

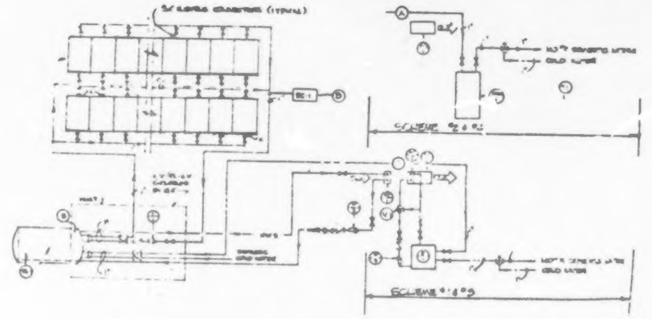
BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with two single family detached dwellings. Each of two-story dwellings with basements has approximately 1,900 square feet of heated floor area. The solar collectors are mounted on the steep south-sloping roof.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X
COLLECTOR: 528 and 576 square feet liquid-cooled flat-plate manufactured by G.E.



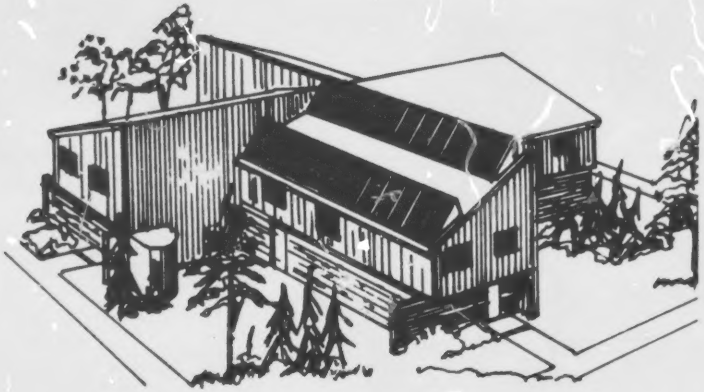
STORAGE: 850 gallons of water within an insulated cylindrical storage tank buried next to the foundation. Heat from the collectors is transferred to the tank by a water to water heat exchanger.

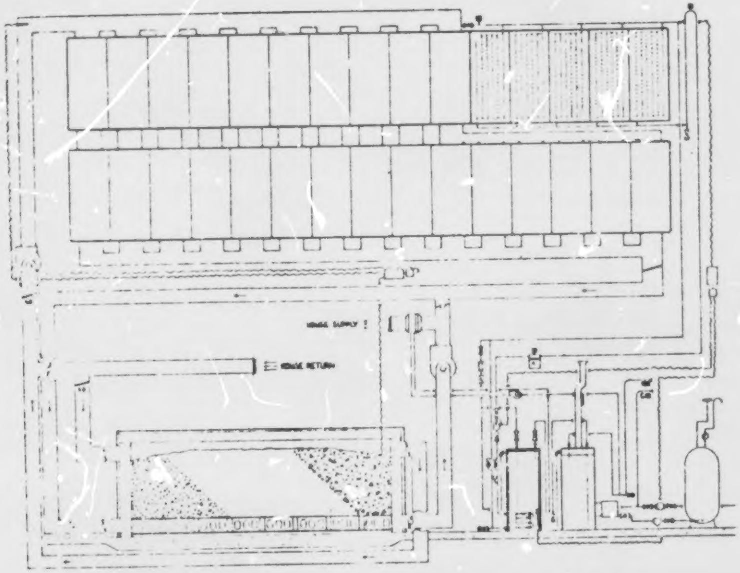
DISTRIBUTION: Forced air. Both house designs utilize a heat coil located in the primary supply duct which is heated by hot water from storage circulating through it. Air is heated as it is blown past the coil en route to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Oil-fired furnace, electric resistance. One scheme has an oil-fired furnace supplying hot water to a fan coil in the supply duct; the other uses an electric resistance coil.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated by circulating the water through a heat exchanger in the storage tank prior to entering the conventional water heater.

COOLING: Natural ventilation.





PROJECT INFORMATION

BUILDER: Housing Authority of Newark

DESIGNERS ARCHITECT: Held and Rubin

ENGINEER : Sunworks

LOCATION: Newark, New Jersey Latitude 40° 44'N.

HOUSING TYPE: Low-Rise Multi-Family

CLIMATIC DATA: DEGREE DAYS **HEATING** 5,034 **COOLING** 150 hrs.

AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 150 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project consists of several individual apartment units modified to include a solar heating and domestic hot water preheating system. One apartment group will have solar heated domestic hot water only. The three and four bedroom, two-story apartments have floor areas of 1,132 and 1,348 square feet respectively. Collectors are roof mounted and storage is located in partially-buried tank adjacent to an outside foundation wall.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: Liquid-cool flat-plate manufactured by Sunworks. The collector area varies from 504 square feet for space heating and domestic hot water heating to 252 square feet for domestic water heating only.

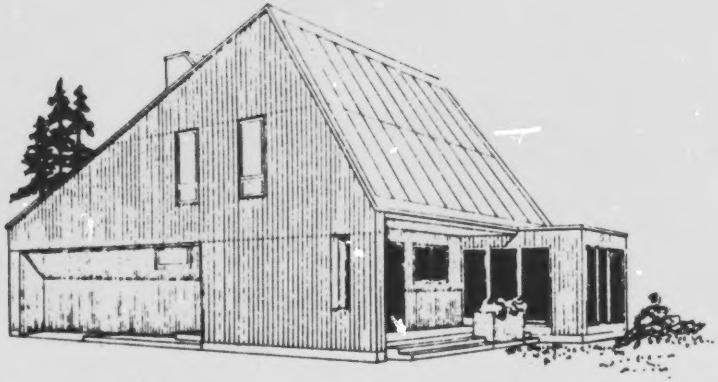
STORAGE: 1,200 to 1,600 gallons of water within an insulated steel tank partially buried adjacent to the building. The domestic hot water system alone has 560 gallons of storage.

DISTRIBUTION: Hydronic heated water from storage is circulated through baseboard convectors located in each apartment.

AUXILIARY ENERGY SYSTEM: Oil-fired boiler. Water from the solar storage tank passes through the boiler en route to distribution. A total or partial energy boost may be supplied.

DOMESTIC HOT WATER SYSTEM: A copper heat exchanger in a 65 gallon stone-lined tank preheats water prior to entering a conventional 140 gallon electric water heater.

COOLING: Natural ventilation.

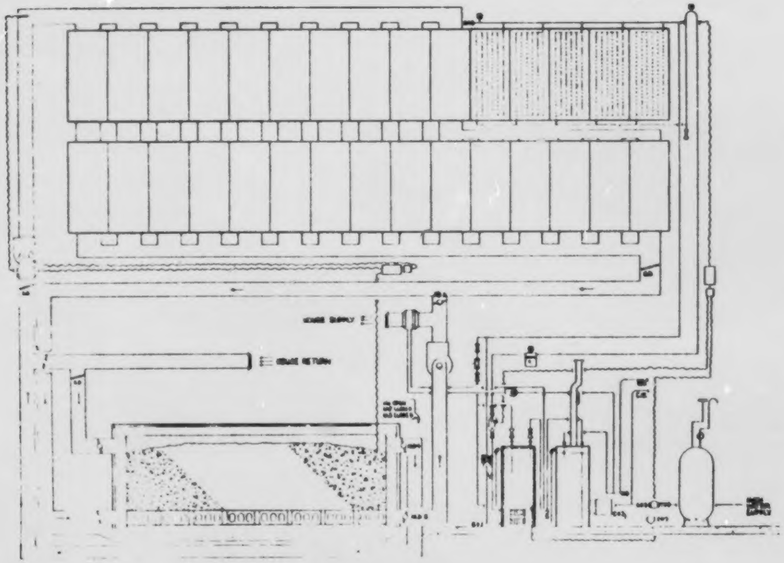


PROJECT INFORMATION

BUILDER: Jespa Enterprises
DESIGNERS **ARCHITECT:** Donald & Marja Watson
ENGINEER: T. Grayson & E. Barber
LOCATION: Old Bridge, New Jersey Latitude 40° 25' N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,980 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70
HORIZ. INSOLATION **JAN.** 150 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The contemporary single family dwelling fits 1,704 square feet of heated floor area into a compact two story plan. The dwelling's compactness as well as increased wall, floor, and ceiling insulation and a sun room greatly improve the building's thermal characteristics. Heating and domestic hot water preheating are provided by a warm-air solar system.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 368.8 square feet air-cooled flat-plage manufactured by Sunworks. A separate 74.2 square feet of liquid-cooled flat-plate collectors are used for domestic hot water preheating.

STORAGE: 840 cubic feet of 2" to 4" rock within a storage bin located beneath the first floor. Domestic hot water storage is separate.

DISTRIBUTION: Forced air. Air is blown through heated rock storage directly to the living space through supply ducts.

AUXILIARY ENERGY SYSTEM: Oil-fired water heater. Water to air heat exchange coil located in primary supply duct provides full or partial energy boost.

DOMESTIC HOT WATER SYSTEM: A copper immersion coil in a closed loop from collectors preheats the domestic water supply in an 80 gallon tank. Water from preheat tank passes through a conventional water heater prior to distribution.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Wayne Nichols-Communico

DESIGNERS **ARCHITECT:** Sun Mountain Design

ENGINEER : Communico

LOCATION: Sante Fe, NM Latitude 36°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA:	**DEGREE DAYS**	**HEATING**	5,886	**COOLING**	700 hrs.
	AVE. TEMP.	**WINTER**	30	**SUMMER**	70°F.
	HORIZ. INSOLATION	**JAN.**	300	**JUNE**	725 Ly.

BUILDING DESCRIPTION

The project is a two-story single family dwelling integrated with a solar heating, cooling, and domestic hot water preheating system. Thick adobe walls behind a south-facing greenhouse of the L-shaped plan absorbs heat and transmits it to the living spaces. Excess heat from the top of the greenhouse is drawn off by two ducts and sent into rock storage bins located below the living and dining room floor. An airlock entry and extra insulation improve the thermal characteristics of the 1,900 square foot dwelling. North walls are wood stud construction with a stucco exterior finish.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: South-facing greenhouse. A separate 34 square foot liquid-cooled flat-plate collector manufactured by Sunsource provides domestic hot water preheating.

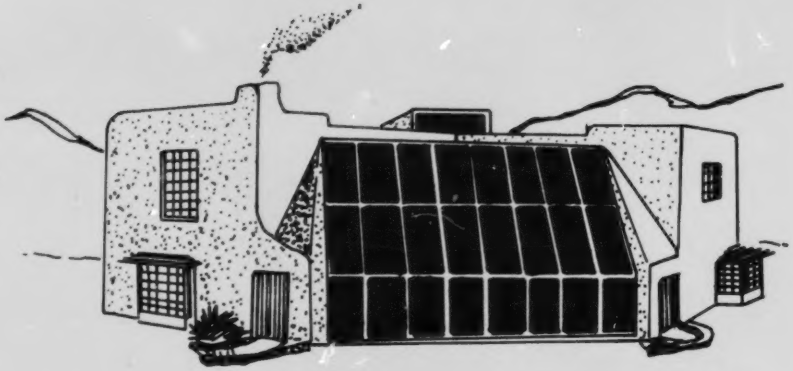
STORAGE: 872 cubic feet of 3"-4" diameter rock within two insulated storage bins beneath the first floor. Domestic hot water storage of 40 gallons is separate.

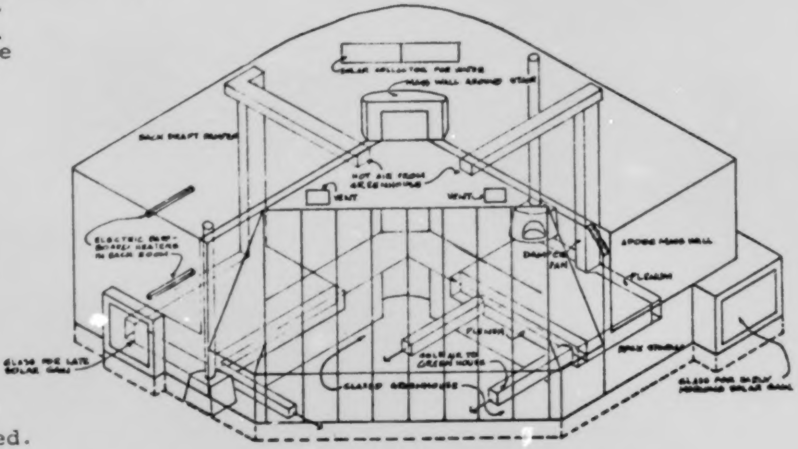
DISTRIBUTION: Forced air. Two ducts draw off excess greenhouse heat to the two rock storage bins. A fan distributes this heat by ducts to the living space. The floor above the storage bins and the adobe wall of the greenhouse act as radiant heat sources.

AUXILIARY ENERGY SYSTEM: Electric coil resistance. A three-stage 10 Kw electric resistance coil in the primary supply. Duct heats air from storage bin as required.

DOMESTIC HOT WATER SYSTEM: A separate liquid-cooled flat-plate collector preheats the domestic hot water supply by circulating the heated water through a heat exchanger in the conventional water heater storage tank.

COOLING: The system is designed to draw cool air into rock storage at night and then distribute cool air to the house during the day.



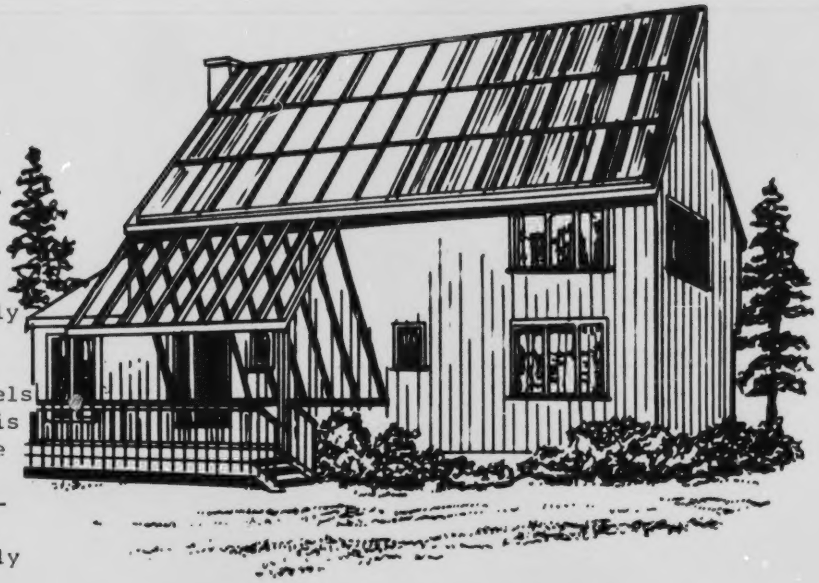

SOLAR COLLECTOR FOR WATER
MASS WALL AROUND STAIR
BACK DRAFT DAMPER
HOT AIR FROM GREENHOUSE
VENT
VENT
ELECTRIC BASE-BOARD HEATERS IN BACK ROOM
ADOBE MASS WALL
DAMPER FAN
PLENUM
PLENUM
ROCK STORAGE
COLD AIR TO GREENHOUSE
GLAZED GREENHOUSE
GLASS FOR LATE SOLAR GAIN
GLASS FOR EARLY MORNING SOLAR GAIN

PROJECT INFORMATION

BUILDER: Innovative Building Systems, Inc.
DESIGNERS **ARCHITECT**:
ENGINEER : Burt, Hill & Assoc. (Solar Design)
LOCATION: Buffalo, New York Latitude 42° 55' N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 7,000 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 66°F.
HORIZ. INSOLATION **JAN.** 120 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project is a large two story contemporary single family dwelling that incorporates a solar heating and domestic hot water preheating system. The wood frame house contains 3,350 square feet of heated floor area on three levels including a full basement. The energy load of the house is reduced by added insulation, double layer glass, and large south-facing windows. The south slope of the double pitched roof is fitted to the optimum angle for solar collection, thereby creating an interesting north-facing clerestory that allows sunlight to enter the second floor family room.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 669 square feet liquid-cooled flat-plate manufactured by PPG. A water-antifreeze solution is used as the heat transfer medium to alleviate potential freezing problems.

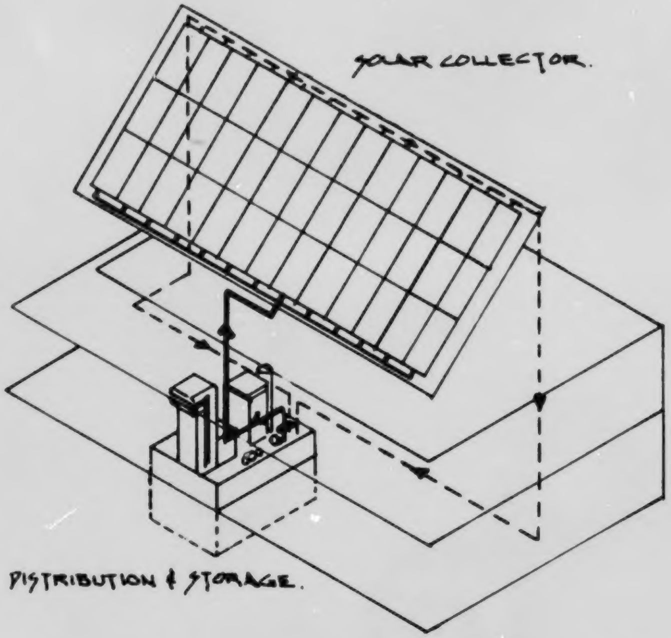
STORAGE: 2,000 gallons of water within an insulated reinforced concrete septic tank. A water to water heat exchanger transfers captured heat from the collectors to the storage media.

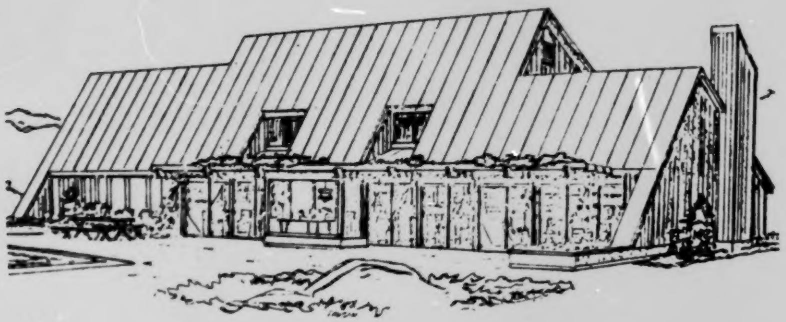
DISTRIBUTION: Forced air. Air is forced over a water to air heat exchanger for distribution to the dwelling spaces by ducts.

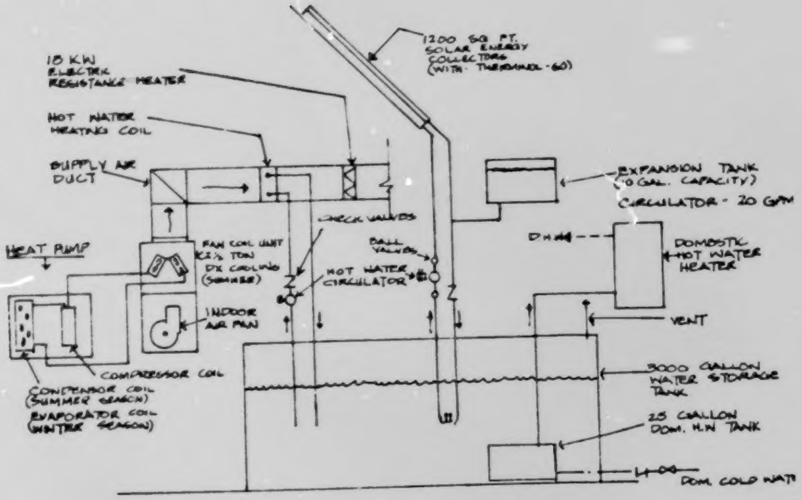
AUXILIARY ENERGY SYSTEM: Two electric heat pumps. One utilizes outside air for operation while the other uses indoor return air. Both are integrated with the solar system.

DOMESTIC HOT WATER SYSTEM: A heat exchanger in storage preheats the water in the 80 gallon tank of the conventional heater. This tank boosts temperature as required.

COOLING: Electric heat pump. An air to air heat pump provides cooling for the dwelling in the summer months.






1200 SQ. FT. SOLAR ENERGY COLLECTORS (WITH THERMANOL-60)
18 KW ELECTRIC RESISTANCE HEATER
HOT WATER HEATING COIL
SUPPLY AIR DUCT
EXPANSION TANK (10 GAL. CAPACITY)
CIRCULATOR - 20 GPM
CHECK VALVES
BALL VALVES
DHW
DOMESTIC HOT WATER HEATER
HEAT PUMP
FAN COIL UNIT (2½ TON DX COOLING (SUMMER)
HOT WATER CIRCULATOR
INDOOR AIR FAN
VENT
COMPRESSOR COIL
3000 GALLON WATER STORAGE TANK
CONDENSOR COIL (SUMMER SEASON)
EVAPORATOR COIL (WINTER SEASON)
25 GALLON DOM. H.W TANK
DOM. COLD WAT

SOLAR AND HEAT PUMP SCHEMATIC DIAGRAM

PROJECT INFORMATION

BUILDER: Solar Structures, Inc.

DESIGNERS **ARCHITECT:** Bill Harz-Wenning

ENGINEER: Solar Structures, Inc.

LOCATION: La Grangeville, NY Latitude 42°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 6,000 **COOLING** 1,200 hrs.

AVE. TEMP. **WINTER** 25 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 130 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project is a two-story, single family detached dwelling with 3,200 square feet of heated floor area utilizing solar energy for heating and domestic hot water preheating. The design incorporates a number of energy conserving features including: south-facing windows with horizontal louvers projected over them to exclude the summer sunlight and to admit the winter sunlight with its beneficial heat gain; a closed water loop to conserve energy normally lost from fireplace, kitchen appliances, laundry, and bathroom fixtures; and added wall, roof and ceiling insulation.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 1,200 square feet liquid-cooled flat-plate manufactured by Revere. The double-glazed panels cover a selectively coated copper absorbing surface.

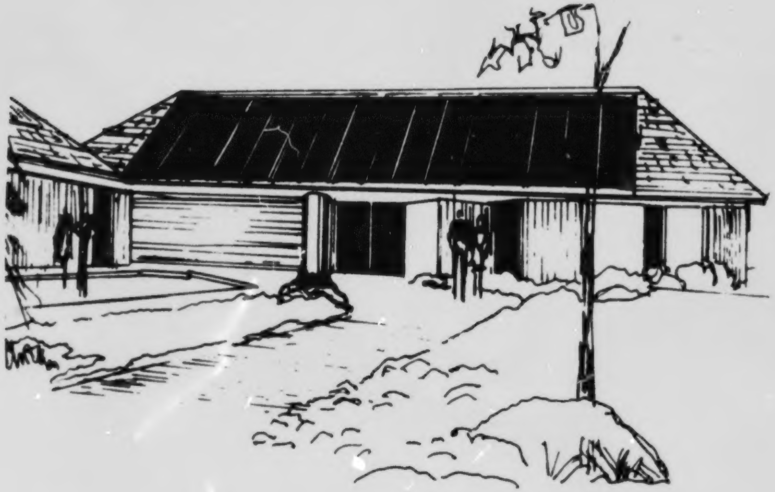
STORAGE: 3,000 gallons of water within an insulated storage tank located in the basement. A water to water heat exchanger transfers heat from the solar collector to the water tank.

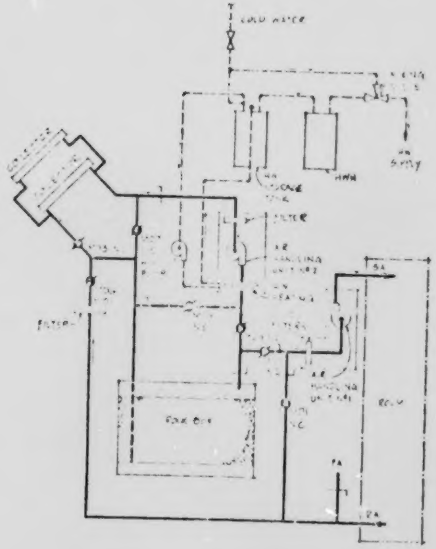
DISTRIBUTION: Forced air. Hot water from storage circulates through a heating coil in the primary supply duct. A fan blows air over the coils. The heated air is distributed by ducts to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electrical resistance heaters, heat pumps. Two 15 KW resistance heaters are located in the pump supply duct in addition to a 2½ ton heat pump with a fan coil unit.

DOMESTIC HOT WATER SYSTEM: The domestic hot water supply is preheated within a 25 gallon tank by circulating "hot" water from the main heat storage tank through copper coils. The preheated water passes through a conventional water heater prior to distribution.

COOLING: Natural ventilation. Heat pump is not solar assisted.





PROJECT INFORMATION

BUILDER: Building Industry Assoc. of Central Ohio
DESIGNERS ARCHITECT: Brubaker/Brandt Inc.
ENGINEER: Gerrit S. van Straten
LOCATION: Dublin, Ohio Latitude 40°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 5,431 **COOLING** 600 hrs.
AVE. TEMP. WINTER 30 **SUMMER** 70°F.
HORIZ. INSOLATION JAN. 130 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project is a single family detached dwelling that employs a solar heating and domestic hot water preheating system. Insulated boards on sliding tracks sealed to jambs with magnetic gaskets control heat losses from the dwelling's large window area. Exterior walls have been insulated with a new sandwich-type sheathing boards with foamed insulation between metallic foil sheets. The circular fireplace is designed for heat recovery. All electric lights have dimmers to reduce energy consumption. Living spaces total 3,648 square feet.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ______ **DHW** X

COLLECTOR: 1,166 square feet air-cooled flat-plate manufactured by Solaron. The black sheet metal absorber has two glass cover plates above and an airduct below.

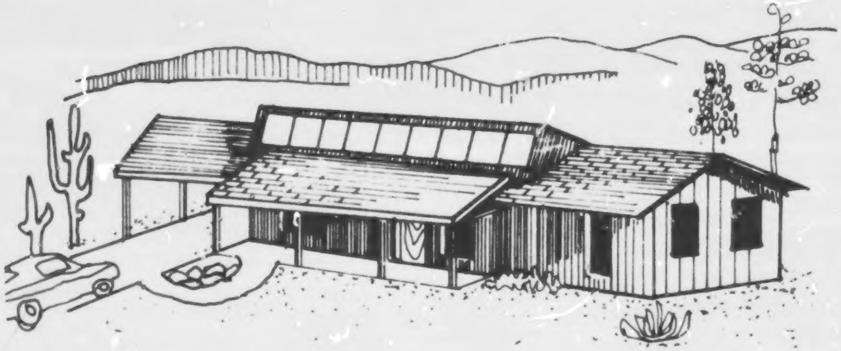
STORAGE: 720 cubic feet of Rocks, 1½" in diameter, within a 10'x10'x7' insulated storage bin.

DISTRIBUTION: Forced air. Air is blown through the rock bin by an air-handling module containing blower, motor and drives. The heated air is distributed through the ducts to living spaces.

AUXILIARY ENERGY SYSTEM: Electrical heat pump. The heat pump draws air over coils in the primary supply duct to supplement the solar heating system.

DOMESTIC HOT WATER SYSTEM: A heat exchange coil in the air-handling module preheats water as air flows from collector to rock storage. The heated water is then returned to a 60 gallon storage tank.

COOLING: Natural ventilation.



PROJECT INFORMATION

BUILDER: Creek Nation Housing Authority

DESIGNERS **ARCHITECT:** Ragsdale & Christensen

ENGINEER: R.D. Evans

LOCATION: Tulsa, Oklahoma Latitude 36°N

HOUSING TYPE: Single Family Detached

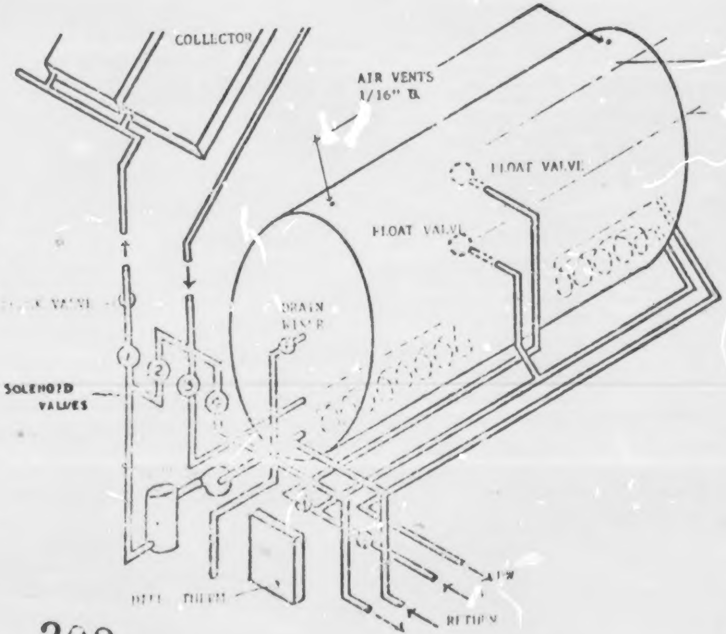
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,050 **COOLING** 800 hrs.

AVE. TEMP. **WINTER** 35 **SUMMER** 75

HORIZ. INSOLATION **JAN.** 205 **JUNE** 600 Ly.

BUILDING DESCRIPTION

Five existing single family homes are to be connected with a solar heating and domestic hot water preheat system. The solar system is designed as an ancillary structure to be sited as dictated by the design and orientation. The ancillary structure can be designed as a carport, covered play area, storage room or other on-site uses. The one story homes to be served by the solar system are approximately 1,050 square feet each.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 234 square feet, liquid-cooled flat-plate manufactured by RAYPAK.

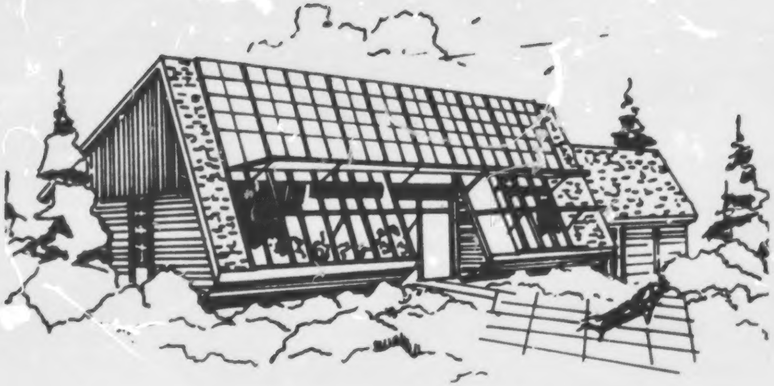
STORAGE: 500 gallons of water within a 3'-9" x 6'-1" tank behind the collector in the pre-assembled ancillary structure.

DISTRIBUTION: Forced air. Heated water from storage flows through coils that transfers the heat to air, then distributed by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Propane-fired furnace. The furnace heats a separate coil located in the primary supply duct. A full or partial energy boost is supplied depending on storage temperature.

DOMESTIC HOT WATER SYSTEM: A 90 gallon propane-fired tank receives water preheated by passing through a copper coil in the main storage.

COOLING: Natural ventilation.



PROJECT INFORMATION

BUILDER: Vincent I. Oredson

DESIGNERS ARCHITECT: Vincent I. Oredson
ENGINEER : None designated

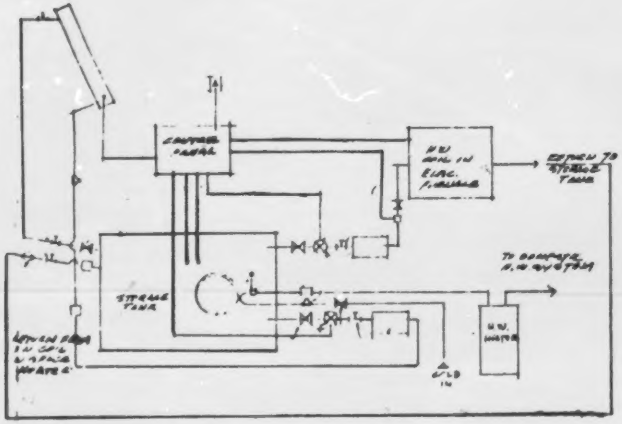
LOCATION: Ashland, Oregon Latitude 42°N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: DEGREE DAYS HEATING 5,000 **COOLING** 650 hrs.
AVE. TEMP. WINTER 35 **SUMMER** 65°F.
HORIZ. INSOLATION JAN. 100 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar space heating and domestic hot water preheating system to a two bedroom, 1,350 square foot, one story residence. Daytime activities areas are located on the south side of the house to take advantage of the light and the heat. The bedrooms are located on the north side of the house. A south-facing greenhouse supplies light and heat to the interior spaces. All south-facing windows are shaded from the summer sunlight to reduce heat gains.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 320 square foot liquid-cooled flat-plate manufactured by West Coast Solar.

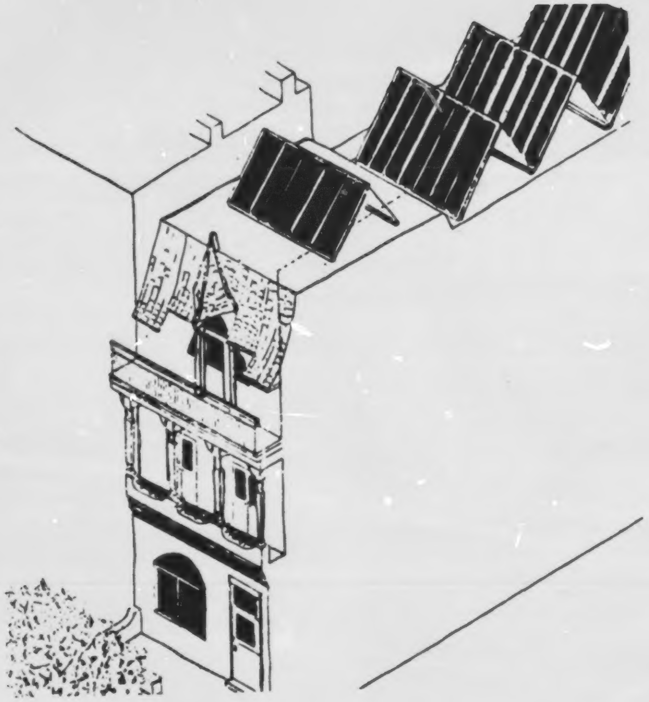
STORAGE: 2,000 gallons of water within an insulated steel tank buried beneath the house.

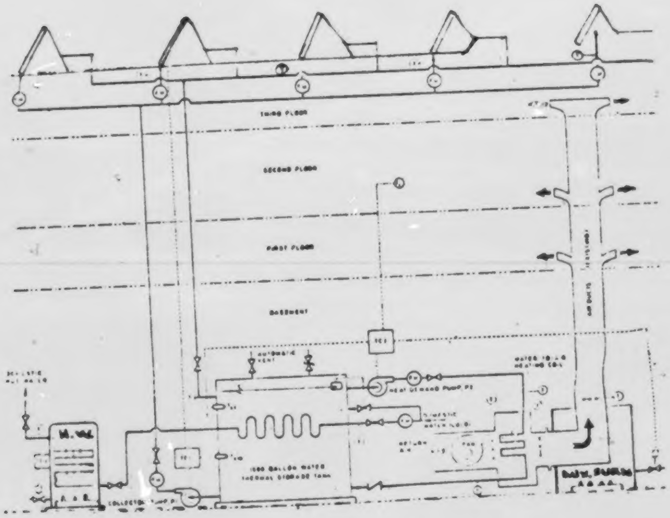
DISTRIBUTION: Forced air. Hot water circulates through coils within the electric furnace. Air is warmed as it passes through coils for distribution by duct to the living spaces.

AUXILIARY ENERGY SYSTEM: Electric furnace. The furnace provides total or supplemental heat as required to the forced air system.

DOMESTIC HOT WATER SYSTEM: A heat exchanger inside the storage tank preheats the water before it enters a conventional 95 gallon water heater.

COOLING: Natural ventilation.




THIRD FLOOR
SECOND FLOOR
FIRST FLOOR
BASEMENT
AUTOMATIC VENT
HEAT DEMAND PUMP P2
WATER TO AIR HEATING COIL
DOMESTIC HOT WATER
1500 GALLON WATER THERMAL STORAGE TANK
COLLECTOR PUMP P1
AIR DUCTS

PROJECT INFORMATION

BUILDER: University of Pennsylvania
DESIGNERS ARCHITECT: Dept. of Engineering
ENGINEER: Dept. of Engineering
LOCATION: Philadelphia, Pennsylvania Latitude 40°N.
HOUSING TYPE: Single Family Attached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,866 **COOLING** 1,680 hrs.
AVE. TEMP. **WINTER** 30 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 150 **JUNE** 520 Ly.

BUILDING DESCRIPTION

The project involves the modification of a three story 3,942 square foot single family dwelling for a solar preheating system and domestic hot water. To reduce heat loss and infiltration all doors and windows are recaulked. The collectors are supported by a structural steel frame on the roof and are connected by transport piping to a storage tank located in the basement.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: 584 square feet liquid-cooled flat-plate manufactured by PPG Inc. and International Environment Corp. The collectors are automatically drained to prevent freezing.

STORAGE: 1,500 gallons of water within two insulated cylindrical tanks 5' diameter by 5' high located in the basement.

DISTRIBUTION: Forced air. Hot water from storage is circulated through a water to air heating coil in the existing ductwork. The air blown over the coil is warmed and distributed by ducts to the occupied areas.

AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace provides supplemental heat as required to the forced air system.

DOMESTIC HOT WATER SYSTEM: A heat exchanger within the main storage tank preheats the domestic hot water supply and possibly is reheated by a conventional water heater.

COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Drexel University

DESIGNERS **ARCHITECT:** Donald C. Larson

ENGINEER : C. William Savery

LOCATION: Philadelphia, PA Latitude 40°N.

HOUSING TYPE: Low-Rise Multi-Family

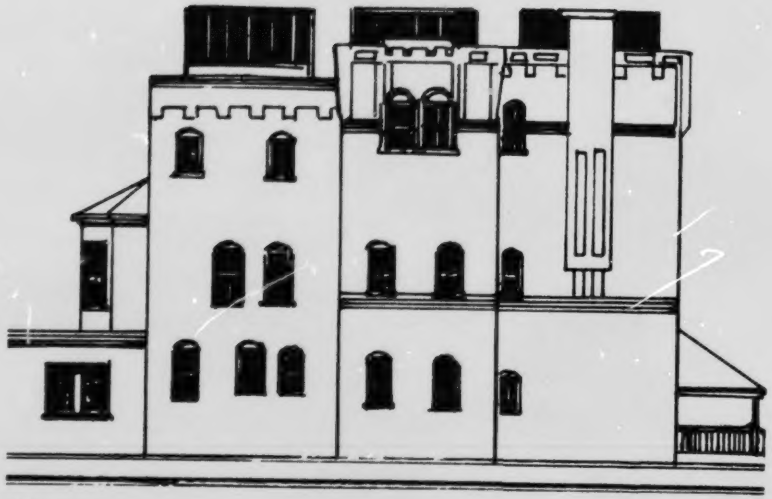
CLIMATIC DATA: **DEGREE DAYS** **HEATING** 4,400 **COOLING** 700 hrs.

AVE. TEMP. **WINTER** 35 **SUMMER** 70°F.

HORIZ. INSOLATION **JAN.** 150 **JUNE** 520 Ly.

BUILDING DESCRIPTION

The project involves the rehabilitation and modification of a three-story, five-unit apartment building to include a solar domestic hot water preheating system. The solar collectors are mounted on a structural frame attached to the flat roof. The solar collectors are connected by piping running the height of the building to the storage tank located in the basement. The hot water from the collectors is used to preheat the domestic hot water supply before it passes through a conventional water heater.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**_____ **COOLING**_____ **DHW** X

COLLECTOR: 270 square feet liquid-cooled flat-plate manufactured by PPG.

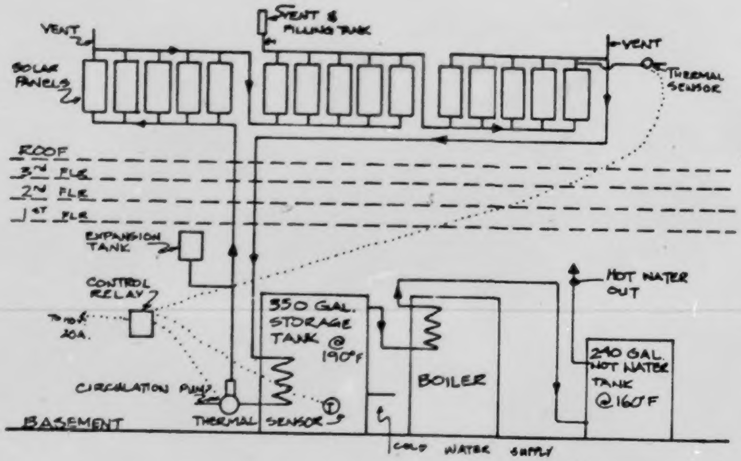
STORAGE: 350 gallons of water within an insulated horizontal cylindrical storage tank located in the basement. Heat is transferred to water storage from the collectors by the use of a heat exchanger.

DISTRIBUTION: Preheated water from the storage tank is circulated through the boiler that maintains a 150°F. temperature in the conventional water heater storage tank.

AUXILIARY ENERGY SYSTEM: Oil-fired boiler. The boiler supplements the preheated water temperature between preheat and regular storage.

DOMESTIC HOT WATER SYSTEM: See collector, storage and distribution above.

COOLING: Not applicable.

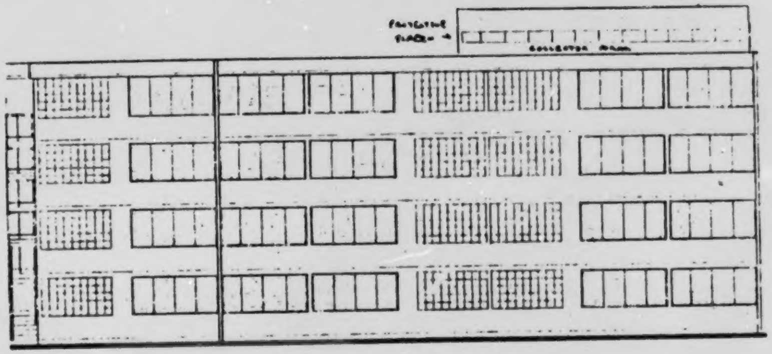

VENT
VENT & FILLING TANK
VENT
SOLAR PANELS
THERMAL SENSOR
ROOF
3RD FLR.
2ND FLR.
1ST FLR.
EXPANSION TANK
CONTROL RELAY
TO 110V. 20A.
350 GAL. STORAGE TANK @ 190°F
BOILER
HOT WATER OUT
240 GAL. HOT WATER TANK @160°F
CIRCULATION PUMP
THERMAL SENSOR
BASEMENT
COLD WATER SUPPLY

PROJECT INFORMATION

BUILDER: Puerto Rico Housing Corp.
DESIGNERS ARCHITECT: Gomez Sampera & Associates
ENGINEER : Solar Products & Devices Inc.
LOCATION: Rio Piedras, Puerto Rico Latitude 18°N.
HOUSING TYPE: Low-Rise Multi-Family
CLIMATIC DATA: DEGREE DAYS **HEATING** ____ **COOLING** 2,750 DD
AVE. TEMP. **WINTER** 65 **SUMMER** 85°F.
HORIZ. INSOLATION **JAN.** 400 **JUNE** 640 Ly.

BUILDING DESCRIPTION

The project involves the installation of a solar domestic hot water system on a 12 unit two story apartment building. The solar collectors are mounted on steel supports located on the building's flat roof. A partial wall surrounds the collectors for protection and visual enclosure. The solar energy system consists of six collector storage modules each serving two apartments.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING**____ **COOLING**____ **DHW** X

COLLECTOR: 216 square feet (36 square per module) liquid-cooled flat-plate manufactured by Solar Products Inc. The collector has a black painted galvanized steel absorber with a plastic or fiberglass cover sheet.

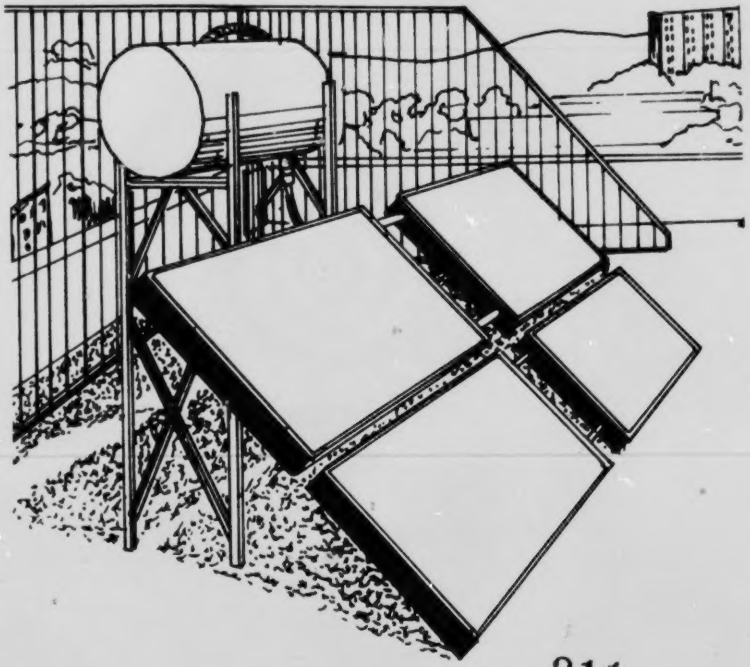
STORAGE: 30 gallons of water within an insulated
glass-lined preheat tank located above the col-
lector module with its own preheat tank. The
30 gallon capacity is used in addition to storage
within the conventional water heater.

DISTRIBUTION: A thermosyphen arrangement transports
heated water from the collector to the preheat
tank. Preheated water is distributed by gravity
to the conventional water heater located in each
apartment.

AUXILIARY ENERGY SYSTEM: An electric heating ele-
ment supplements the temperature required of
preheated water in the conventional heater.

DOMESTIC HOT WATER SYSTEM: See collector, storage, and distribution for details.

COOLING: Not applicable.



210

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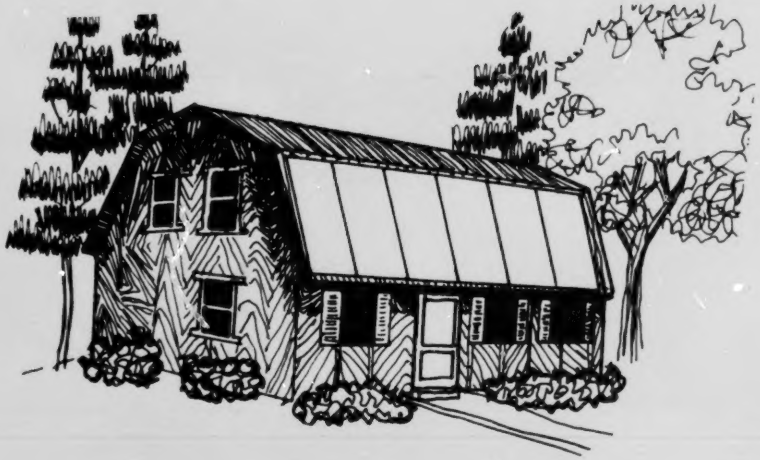
PROJECT INFORMATION

BUILDER: Church Community Corporation
DESIGNERS **ARCHITECT**: Ade Bethune
ENGINEER : Gordon Preiss
LOCATION: Newport, R.I. Latitude 41.5°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 5,972 **COOLING** 250 hrs.
AVE. TEMP. **WINTER** 25 **SUMMER** 70°F.
HORIZ. INSOLATION **JAN.** 155 **JUNE** 527 Ly.

BUILDING DESCRIPTION

The project combines a 1,400 square foot single family detached dwelling with a solar heating and domestic hot preheating water system. Collectors form an integral part of the south-facing roof. To reduce heat losses additional insulation is placed in the floors, walls, and ceiling. Also winter heat loss is reduced by the use of storm windows. To accommodate the added wall insulation 2"x6" studs spaced 24" on center are used.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 432 square feet air-cooled flat-plate manufactured by Church Development Corp. Air flows through a duct formed by two layers of a double plastic panel.

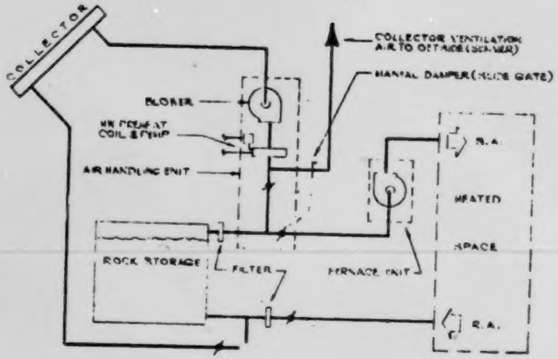
STORAGE: 600 cubic feet of 2½" diameter rock within an insulated concrete bin located in the basement.

DISTRIBUTION: Forced air. Air is blown through the rock storage bin by an auxiliary blower in the primary supply duct. A blower in the furnace distributes the hot air to living spaces through supply ducts.

AUXILIARY ENERGY SYSTEM: Oil-fired furnace. The furnace provides supplemental heat to the solar energy system as required.

DOMESTIC HOT WATER SYSTEM: A finned copper coil in the rock storage bin preheats the domestic water supply prior to entering a 30 gallon conventional water heater.

COOLING: Natural ventilation.


COLLECTOR
COLLECTOR VENTILATION AIR TO OUTSIDE (SUMMER)
MANUAL DAMPER (SLIDE GATE)
BLOWER
HW PREHEAT COIL & PUMP
AIR HANDLING UNIT
R.A.
HEATED
SPACE
ROCK STORAGE
FILTER
FURNACE UNIT
R.A.

PROJECT INFORMATION

BUILDER: The Cambridge Development Group

DESIGNERS **ARCHITECT:** James H. Livingston
ENGINEER: Wormser Scientific

LOCATION: Columbia, South Carolina Latitude 34° N

HOUSING TYPE: Single Family Attached

CLIMATIC DATA:

DEGREE DAYS	**HEATING**	2,435	**COOLING**	1,359 hr
AVE. TEMP.	**WINTER**	45	**SUMMER**	75°F.
HORIZ. INSOLATION	**JAN.**	230	**JUNE**	560 Ly.

BUILDING DESCRIPTION

The project is a four townhouse unit consisting of two two-story 2,530 square feet living units on the ends, and two three-story 1,570 square feet living units in the middle. This particular solar project represents one four-unit building in the second phase of a three phase 398 unit townhouse condominium development. The solar system is integrated with the building design with the collectors located in glass-covered attic space and the storage tanks located in the basement. Energy conserving features include improved wall and roof insulation, double glazing on all windows, and glass doors and large south-facing windows.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X

COLLECTOR: Two 500 square foot pyramidal optic reflective surfaces concentrate solar radiation onto a small (44' x 96") liquid-cooled flat-plate collector manufactured by Olin Brass & Copper. The panel is recessed in the roof. This solar collection concept is patented by Wormser Scientific.

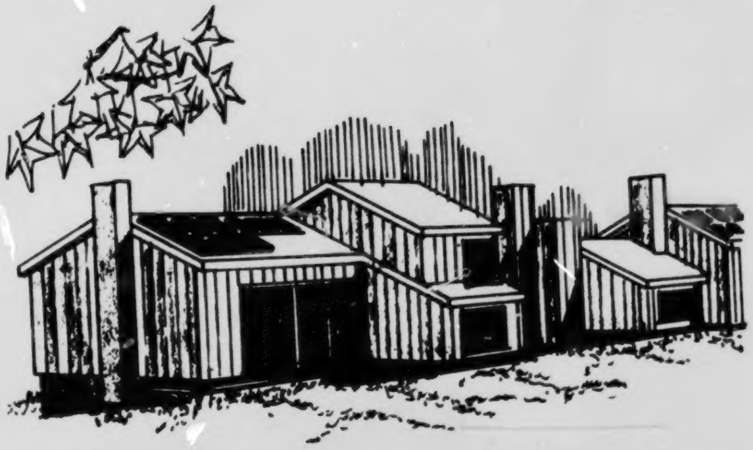
STORAGE: 2,000 gallons of water within two insulated reinforced concrete tanks located in the basement. A heat exchanger transfers heat from the collectors to the storage media.

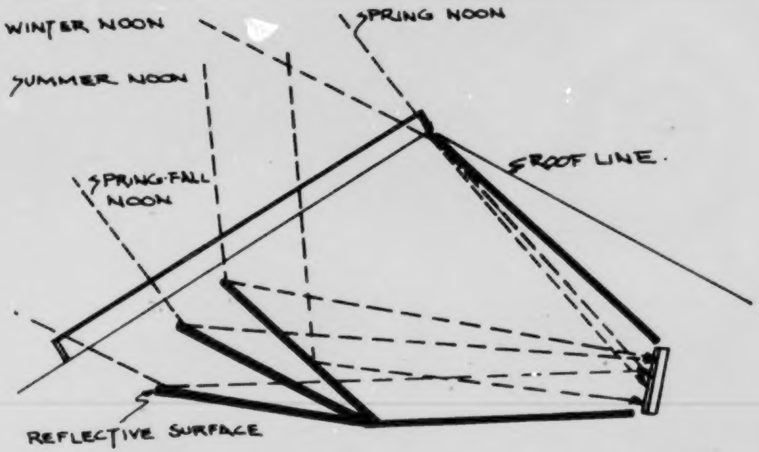
DISTRIBUTION: Forced air. A heat exchanger is integrated with a heat pump to transfer heat from storage to the occupied spaces. Air is circulated over the exchange coils and distributed by ducts.

AUXILIARY ENERGY SYSTEM: Electric heat pump with electric resistance elements in primary supply ducts. Temperature sensors within storage and supply ducts determine when auxiliary energy is required.

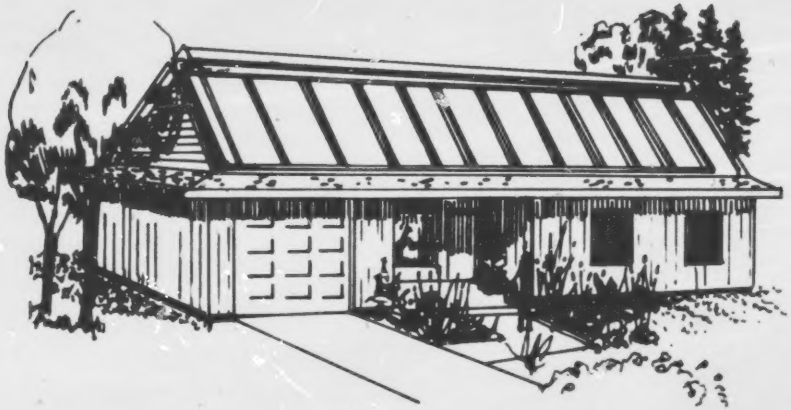
DOMESTIC HOT WATER SYSTEM: 200 gallon domestic hot water preheat tank is located within the central space heating storage tank. Preheated water passes through a conventional water heater where a total or partial energy boost may be supplied if needed.

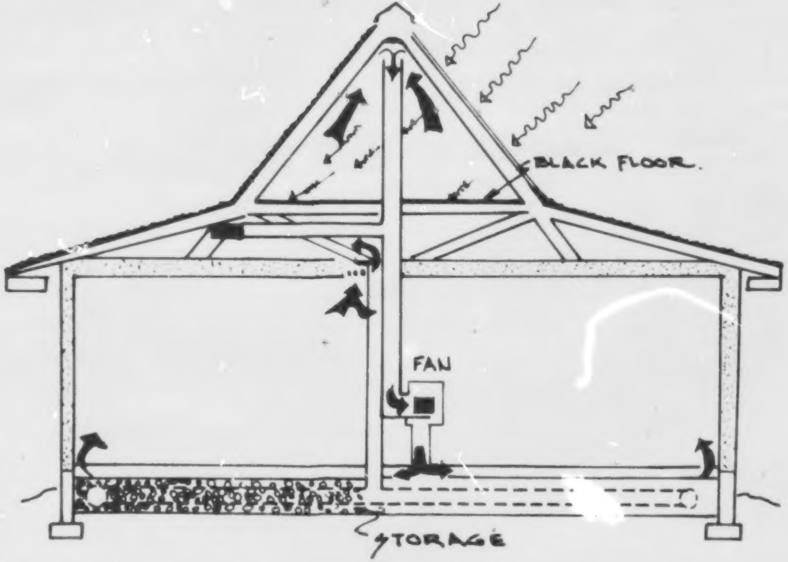
COOLING: Electric heat pump, natural ventilation. Cooling by air to air heat pump is not solar assisted.





SECTION OF SOLAR COLLECTOR WITHIN ATTIC SPACE





PROJECT INFORMATION

BUILDER: Helio Thermics, Inc.
DESIGNERS **ARCHITECT:** H.F. Zornig
ENGINEER : Helio Thermics, Inc.
LOCATION: Greenville, South Carolina Latitude $34.5^{O}N$
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 2,884 **COOLING** 750 hrs.
AVE. TEMP. **WINTER** 45 **SUMMER** $80^{O}F$.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 560 Ly.

BUILDING DESCRIPTION

The project is a low-cost one story single family dwelling that uses an attic space as the solar collector. The 1,080 square foot wood frame house is well insulated, and an air space separates the solar heated, black painted, plywood floor of the attic from the ceiling. In winter the south-facing glazed roof collects heat in the unventilated attic. The heated air is removed to rock storage located in a crawl space under the floor. A continuous operable ridge vent ventilates the attic in the summer.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** ____

COLLECTOR: 412.5 square foot air-cooled flat-plate manufactured by Helio Thermics, Inc. The attic collector admits solar radiation through a transparent fiberglass glazed southern roof to a black painted plywood attic floor.

STORAGE: 1,080 cuibc feet of one and one-half inch rock are located in a 1' x 27' x 40' crawl space. At $50^{O}F$. 20 BTU's are stored per cubic foot of rock.

DISTRIBUTION: Forced air. A thermostatically controlled fan on the ground floor circulates attic heated air to rock storage. The heat is then distributed radiantly to the living space. A manually operated ridge vent controls ventilation.

AUXILIARY ENERGY SYSTEM: Gas furnace located on the first floor between the fan and rock storage. The furnace supplies back-up heat whenever heat from the storage is insufficient.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is heated by a conventional gas water heater.

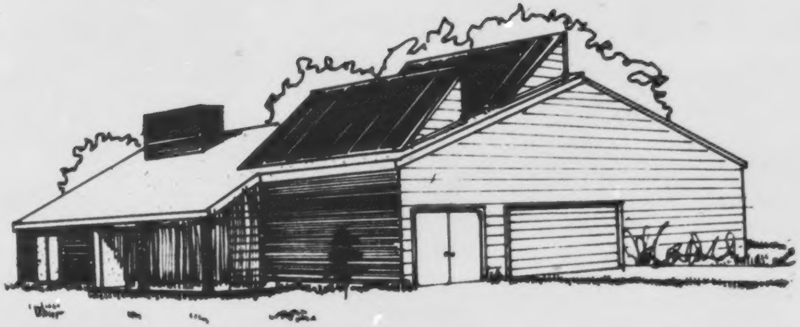
COOLING: Heat built up in rock storage during the day is removed by venting through the attic space at night.

PROJECT INFORMATION

BUILDER: W. Brown Builders
DESIGNERS ARCHITECT: Travis-Braun & Associates
ENGINEER: Dring Engineering Co.
LOCATION: Dallas, Texas Latitude 32°54'N.
HOUSING TYPE: Two - Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 2,382 **COOLING** 2,587 hrs.
AVE. TEMP. WINTER 50 **SUMMER** 80°F.
HORIZ. INSOLATION JAN. 250 **JUNE** 650 Ly.

BUILDING DESCRIPTION

The project applies solar energy for space heating and domestic hot water to two single family detached dwellings. The first home is a 3,395 square foot brick and cedar-sided ranch house. To conserve energy window areas facing north, west and east are reduced and the roof overhang is designed to shade large south-facing windows in summer and admit the heat of sunlight in winter. The second bricked, wood frame residence has 2,300 square feet of living space. Both dwellings have the solar collectors mounted at the optimum tilt on the sloping south-facing roof.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ___ **DHW** X

COLLECTOR: 504 square feet (first house) and 417 square feet (second house) liquid-cooled flat-plate manufactured by Sunsource.

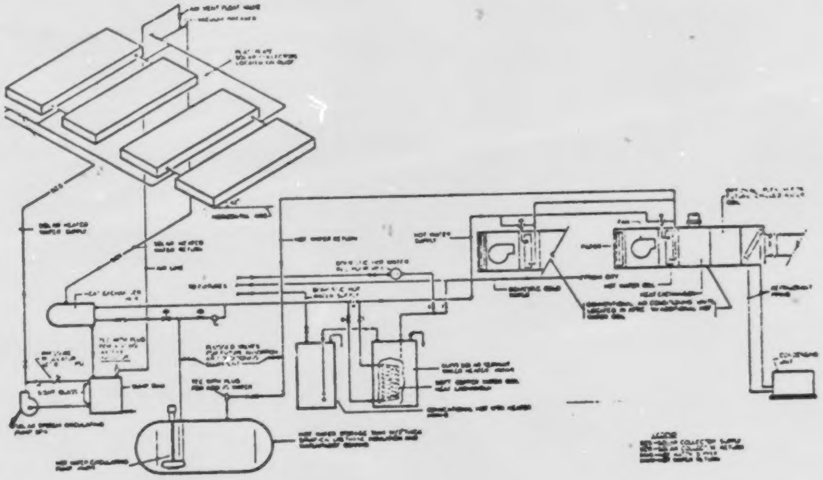
STORAGE: 2,000 gallons of water within an insulated storage tank located in the basement. A heat exchanger transfers energy from the collector to a sump tank which is then transfered to the central storage tank.

DISTRIBUTION: Forced air. Hot water from storage passes through some heat exchanger coils in the supply air ductwork. A fan circulates air past the coils through the house via the ducts.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace located within the primary supply duct provides supplemental heating as required.

DOMESTIC HOT WATER SYSTEM: 120 gallons of water within an insulated tank is preheated as water from storage is pumped to the distribution fan unit. The preheated water passes through a conventional heater before distribution.

COOLING: Conventional gas fired air conditioner and natural ventilation.



PROJECT INFORMATION

BUILDER: Gordon Deering
DESIGNERS **ARCHITECT:** Kiesling
ENGINEER : Sheridan
LOCATION: Lubbock, Texas Latitude 33°39'N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 3,578 **COOLING** 1,647 hrs.
AVE. TEMP. **WINTER** 40 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 250 **JUNE** 650 Ly.

BUILDING DESCRIPTION

The project is a 4,050 square foot single family dwelling integrated with a solar heating and domestic hot water preheating system. The high wind velocities associated with the area dictated a low-profile building and collector area. The thermal mass of the house was increased by the use of thick masonry walls and floors. Additional energy conserving features include: improved insulation, reduced infiltration, supply air, and an overhang to block the summer sun. Also, glass area is minimized and windows are double glazed.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ____ **DHW** X
COLLECTOR: 312 square feet air-cooled flat-plate manufactured by Solaron.

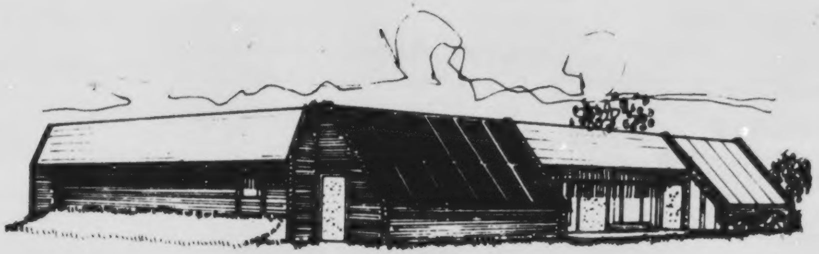
STORAGE: 9.4 tons of rock 3/4" to 1 1/2" diameter within a triangular rock bin behind the collector. There are 60 pounds per square foot of collector.

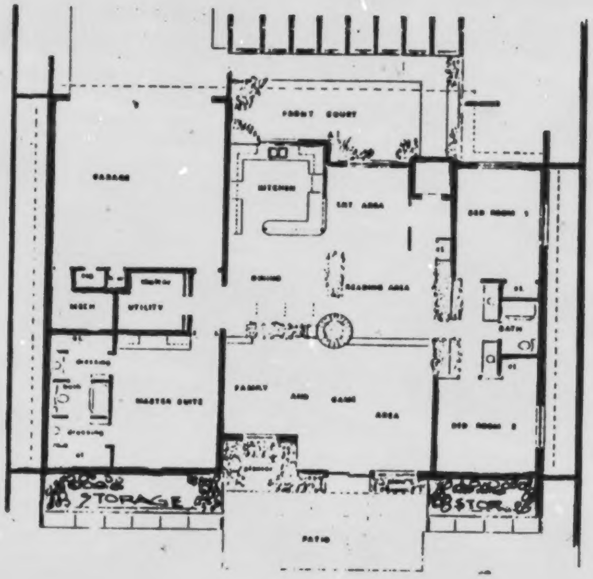
DISTRIBUTION: Forced air. Air is blown through the rock storage by an air to air heat pump with a two-speed fan for circulation. The ductwork is installed in the ceiling with insulated air mains.

AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace provides supplemental heat as required. Cooling is achieved electrically.

DOMESTIC HOT WATER SYSTEM: 80 gallons of water are stored in a conventional hot water tank. Water is preheated by a heat exchanger in the ductwork.

COOLING: Natural ventilation. Heat pump is not solar assisted.





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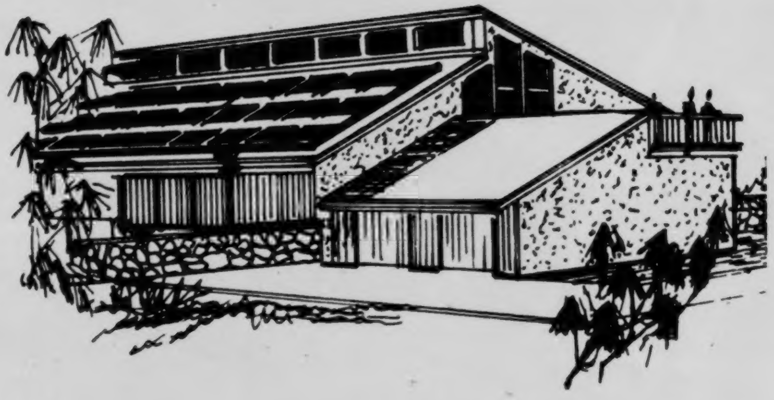
PROJECT INFORMATION

BUILDER: San Antonio Ranch Ltd.
DESIGNERS **ARCHITECT:** Harding, Flores & Madrid
ENGINEER: Honeywell Inc.
LOCATION: San Antonio, TX Latitude 29° 30'N.
HOUSING TYPE: Three Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 1,546 **COOLING** 2,000 hrs
AVE. TEMP. **WINTER** 55 **SUMMER** 80°F.
HORIZ. INSOLATION **JAN.** 280 **JUNE** 610 Ly.

BUILDING DESCRIPTION

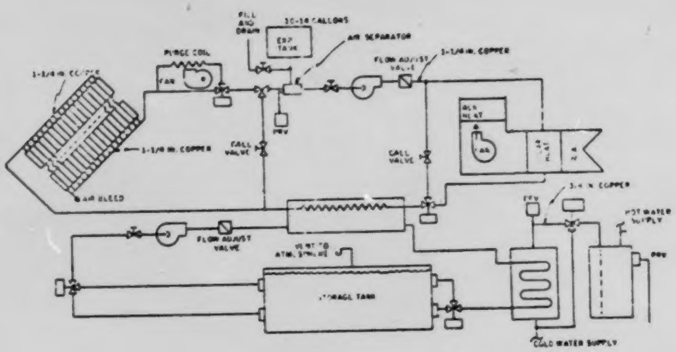
The project involves the integration of a solar heating
and cooling system into three single family detached dwel-
lings. The contemporarily-styled homes have floor areas
of 2,044, 1,825, and 1,814 square feet. All are two
stories in height and built without a basement. One
dwelling makes use of prefabricated concrete wall panels
with a site applied coating of stucco. Added wall,
floor and ceiling insulation reduce the dwelling's heat
losses. The solar collectors are incorporated on the
houses sloping south-facing roofs.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** ____

COLLECTOR: 850 (approximately) square feet liquid-cooled flat-plate manufactured by Lennox per dwelling.


1-1/4 in. COPPER
PURGE COIL
FAN
FILL AND DRAIN
EXP TANK
AIR SEPARATOR
FLOW ADJUST VALVE
1-1/4 in. COPPER
PRV
BALL VALVE
1-1/4 in. COPPER
BALL VALVE
AUX HEAT
FAN
AIR BLEED
3/4 in. COPPER
PRV
HOT WATER SUPPLY
FLOW ADJUST VALVE
VENT TO ATMOSPHERE
STORAGE TANK
PRV
COLD WATER SUPPLY

STORAGE: 1,000 gallons of water within a 5'4" diameter storage tank buried in the ground.

DISTRIBUTION: Forced air. Heated water from storage passes through heat exchange coils in the primary supply duct. A fan in the ductwork circulates air through the coils, warming the air, which is distributed to the living spaces.

AUXILIARY ENERGY SYSTEM: Gas-fired boiler. The boiler provides hot water to the heating coils when storage temperatures cannot satisfy the dwelling's total heating demand.

DOMESTIC HOT WATER SYSTEM: Conventional system

COOLING: An Arkla Absorption cooling unit. Uses water from solar storage to develop cold water which is pumped through coils in the primary supply duct.

PROJECT INFORMATION

BUILDER: Terracor, Utah

DESIGNERS **ARCHITECT**: Richard L. Crowther

ENGINEER: Solaron Corporation

LOCATION: Salt Lake City, UT Latitude 40°47'N.

HOUSING TYPE: Single Family Detached

CLIMATIC DATA: **DEGREE DAYS** **HEATING** 5,980 **COOLING** 927 hrs

AVE. TEMP. **WINTER** 20 **SUMMER** 65°F.

HORIZ. INSOLATION **JAN.** 165 **JUNE** 620 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating system to a 3,000 square foot single family dwelling. The three-story split-level house integrates the solar system within the building. A number of energy conserving features are incorporated in the design to reduce the dwelling heat loss. These include a skylit airlock entry, double-glazed windows where the outer pane is insulated and the inner pane reflective and 2"x6" studs spaced 24" on center to allow for thicker wall insulation.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** ___ **DHW** ___

COLLECTOR: 585 square feet air-cooled flat-plate manufactured by Solaron Corporation.

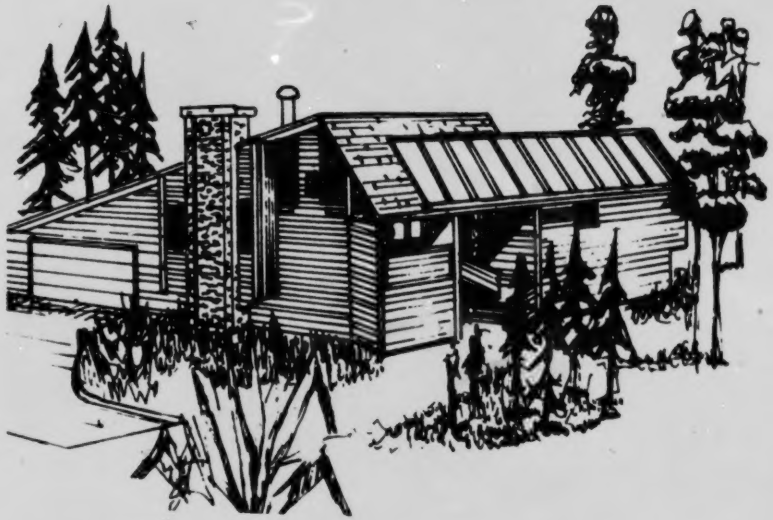
STORAGE: 16 tons (295 cubic feet) of 1½" diameter rock within an insulated storage bin located in the basement.

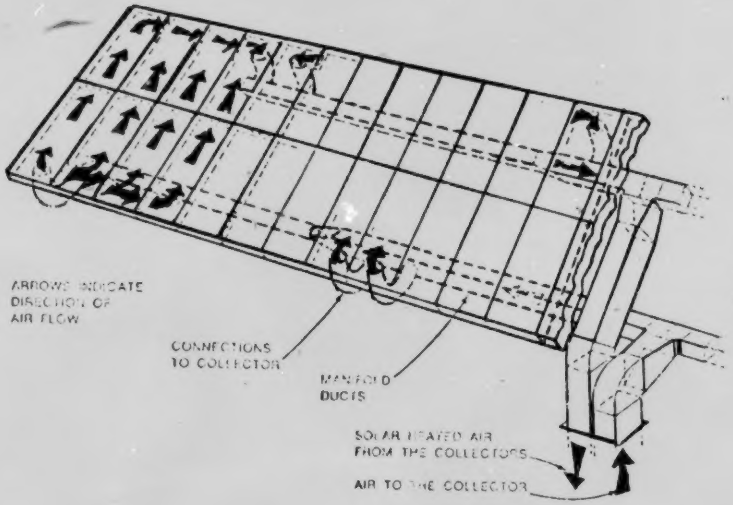
DISTRIBUTION: Forced air. An air handling unit transports heated air from the collector to the rock storage bin. Warmed air is removed from rock storage by a fan and distributed throughout the house by ducts.

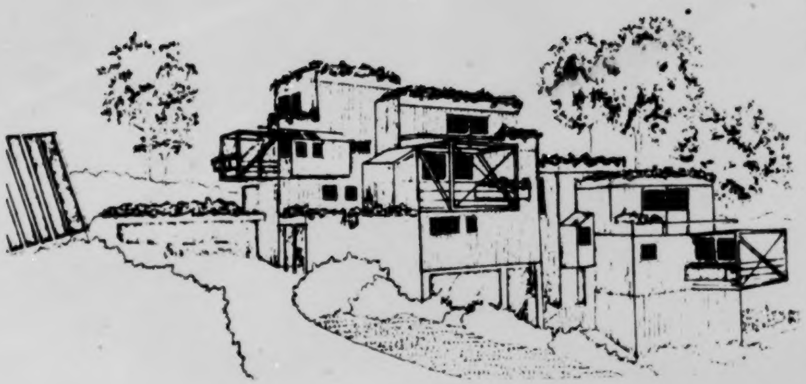
AUXILIARY ENERGY SYSTEM: Gas-fired furnace. The furnace is located on-line between rock storage and occupied spaces, apply total or partial heating as required.

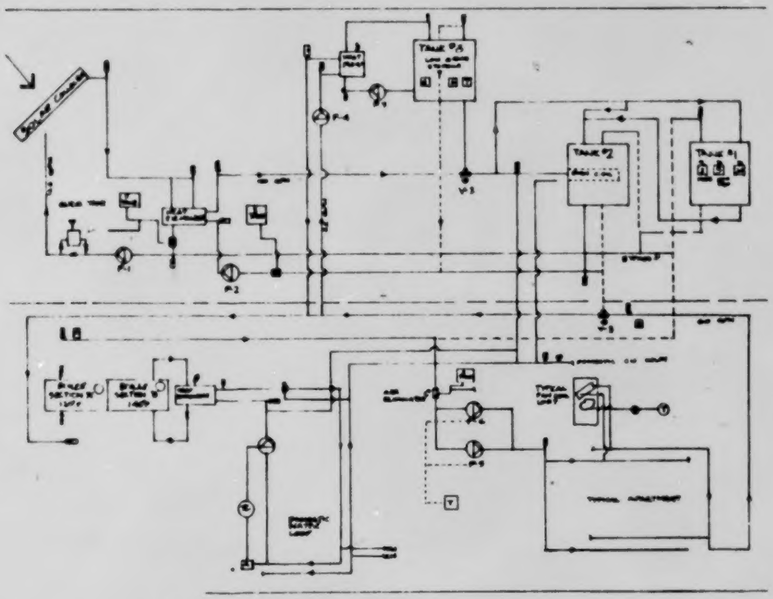
DOMESTIC HOT WATER SYSTEM: Conventional system.

COOLING: Natural ventilation.









PROJECT INFORMATION

BUILDER: Grassy Brook Village
DESIGNERS ARCHITECT: Robert F. Shannon
ENGINEER : Dubin-Mindell-Bloome & Associates
LOCATION: Brookline, Vermont Latitude 43°N
HOUSING TYPE: Clustered Condominiums - 10 units
CLIMATIC DATA: DEGREE DAYS HEATING 7,800 **COOLING** ____
AVE. TEMP. WINTER 15 **SUMMER** 65°F.
HORIZ. INSOLATION JAN. 120 **JUNE** 500 Ly.

BUILDING DESCRIPTION

The project consists of ten three-bedroom, 1,200 square foot living units clustered around a common courtyard to form a 12,000 square foot modular complex. The complex makes use of a shared central solar collection and storage system. The collectors and storage elements are located apart from the buildings. Energy conservation features include: common walls reducing by 18 percent vertical exterior wall area exposed to outside, double-glazed windows, extra insulation, and sodded roof.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 2,520 square feet liquid-cooled, flat-plate arranged in an array of three rows, two panels high each in a sawtooth fashion.

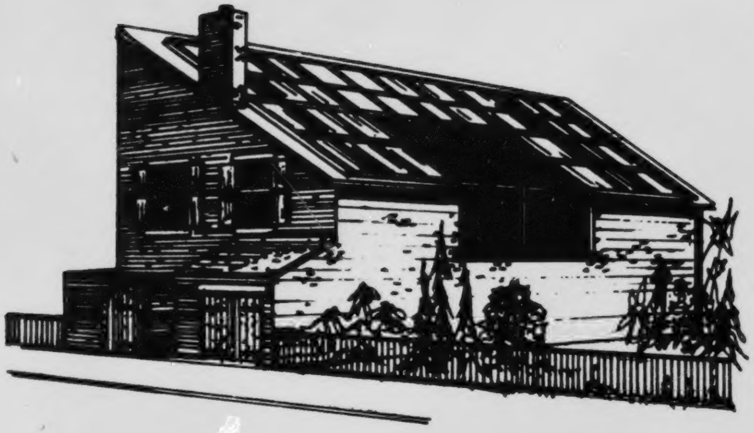
STORAGE: Three 5,000 gallon steel tanks store 15,000 gallons of water to be heated by heat exchange coils from the collectors.

DISTRIBUTION: Forced air. Six fan-coil units per dwelling distribute heat air from the central heating system. A ten-ton electric heat pump is connected to a separate 5,000 gallon tank receiving low-grade heat from the collectors.

AUXILIARY ENERGY SYSTEM: An oil-fired boiler has the capacity to provide 100 percent of required heating. Wood stoves in each dwelling provide back-up.

DOMESTIC HOT WATER SYSTEM: A preheat coil from the collectors heats 600 gallons of water stored in a separate domestic hot water storage tank.

COOLING: Natural ventilation.

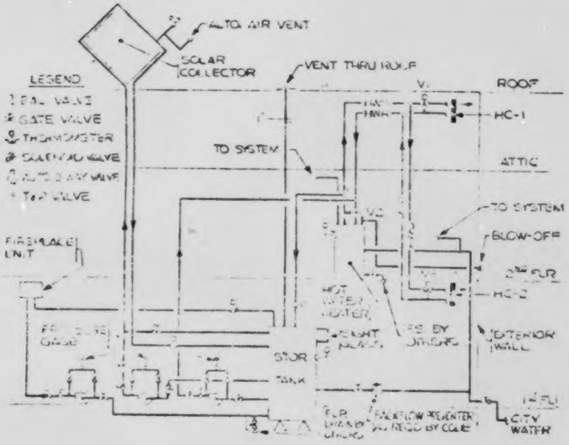


PROJECT INFORMATION

BUILDER: Rust Construction Co.
DESIGNERS ARCHITECT: Rust Construction Co.
ENGINEER: Inter-Technology Corp.
LOCATION: Alexandria, VA Latitude 39°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 4,211 **COOLING** 850 hrs.
AVE. TEMP. WINTER 30 **SUMMER** 70°F.
HORIZ. INSOLATION JAN. 175 **JUNE** 550 Ly.

BUILDING DESCRIPTION

The project combines a solar heating and domestic hot water preheating system with a two-story 2,115 square foot single family residence. Roof-mounted collectors are connected with a water storage tank located in the basement. A skylight in the center of the south-facing roof supplies light as well as heat to the dwelling's interior spaces.



AUTO. AIR VENT
SOLAR COLLECTOR
VENT THRU ROOF
ROOF
LEGEND
BALL VALVE
GATE VALVE
THERMOMETER
SOLENOID VALVE
AUTO 3 WAY VALVE
T&P VALVE
TO SYSTEM
HC-1
ATTIC
TO SYSTEM
BLOW-OFF
FIREPLACE UNIT
2nd FLR
HC-2
HOT WATER HEATER
PRESSURE GAGE
SIGHT
BY OTHERS
EXTERIOR WALL
STOR TANK
FLR DRAIN BY OTHERS
BACKFLOW PREVENTER AS REQD BY CODE
1st FLR
CITY WATER

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SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ______ **DHW** X

COLLECTOR: 459 square foot liquid-cooled flate-plate manufactured by Solar Corp. Above the selective coating on an aluminum absorber are two glass cover plates.

STORAGE: 1,000 gallons of water within an insulated 4' diameter by 11' long storage tank located in the basement.

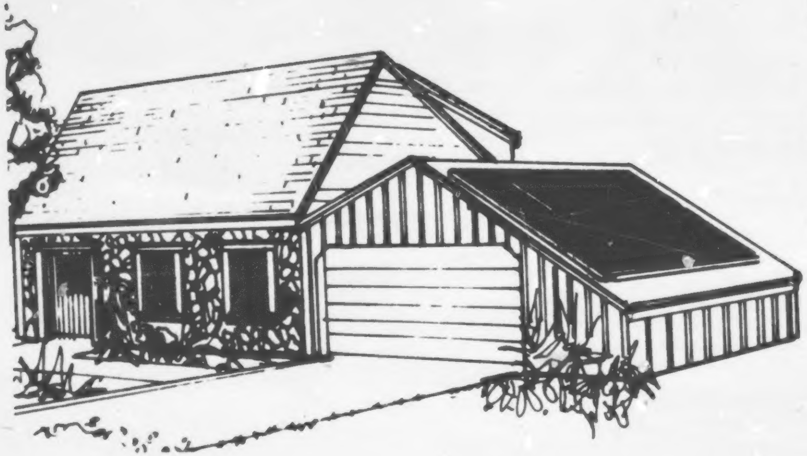
DISTRIBUTION: Forced air. Hot water from storage is circulated through coils in the primary supply ducts. A fan distributes the air warmed by the coils to the living spaces by ducts.

AUXILIARY ENERGY SYSTEM: Electrical resistance, heat pump. Electric resistance coils in the supply ducts plus a heat pump provide a total or partial energy source to the solar heating system.

DOMESTIC HOT WATER SYSTEM: Hot water from storage circulates through a heat exchanger within a conventional water heater preheated the domestic hot water supply.

COOLING: Heat pump, but not solar assisted. Natural ventilation.

229

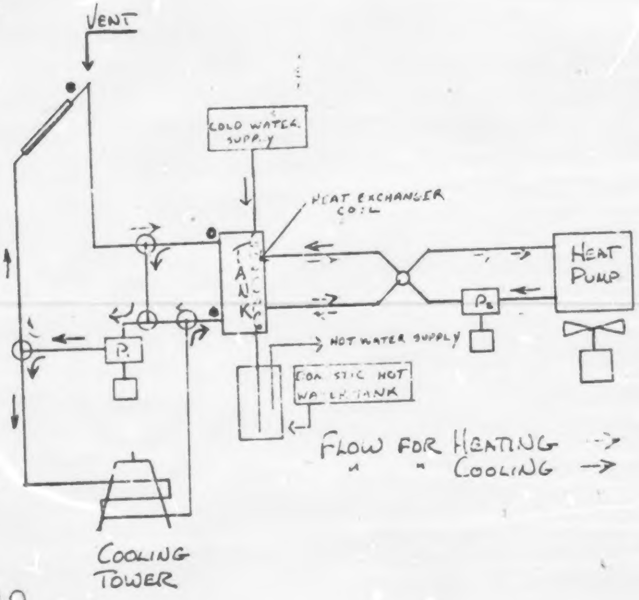


PROJECT INFORMATION

BUILDER: Ritter Buildings
DESIGNERS **ARCHITECT:** D.H. Lufkin
ENGINEER: Euda Corporation
LOCATION: Berryville, Virginia Latitude 39°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 4,679 **COOLING** 1,046 hrs.
AVE. TEMP. **WINTER** 35 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 175 **JUNE** 555 Ly.

BUILDING DESCRIPTION

The project involves the application of a solar heating, cooling and domestic hot water preheating system to a single family detached dwelling. The two-story house has 1,664 square feet of heated/cooled floor area. The design is compact and well-insulated. Roof-mounted collectors on the garage heat thermal storage located in the basement.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: **HEATING** X **COOLING** X **DHW** X

COLLECTOR: 210 square foot liquid-cooled flat-plate manufactured by Sunworks.

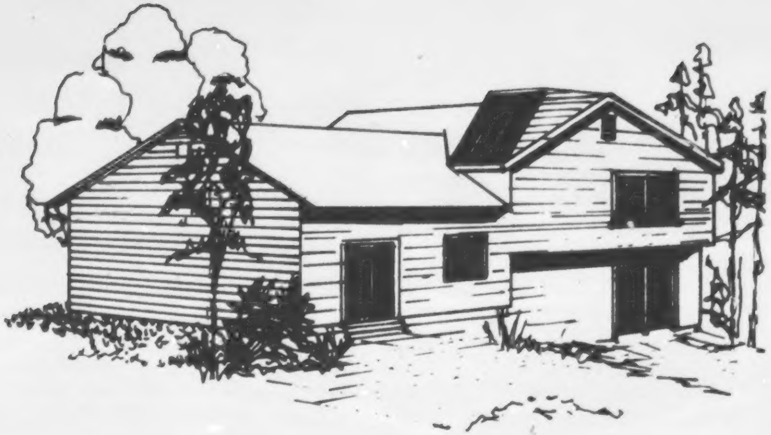
STORAGE: 1,250 gallons of water within concrete storage tank coated with polyester and epoxy located in the basement.

DISTRIBUTION: Forced air. Hot water from storage passes through a heat pump arranged in-line with the distribution ducts. Air is blown over copper coils, heated and distributed to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Electrical resistance, heat pump. 14.4 KW strip heater located in the primary supply duct along with the heat pump provides supplemental energy as required.

DOMESTIC HOT WATER SYSTEM: A copper coil in storage preheats the domestic hot water supply prior to entering a conventional 60 gallon electric water heater.

COOLING: Solar assisted heat pump. Main thermal storage receives heat removed during daytime by the heat pump to be disposed of to the cooling tower at night.

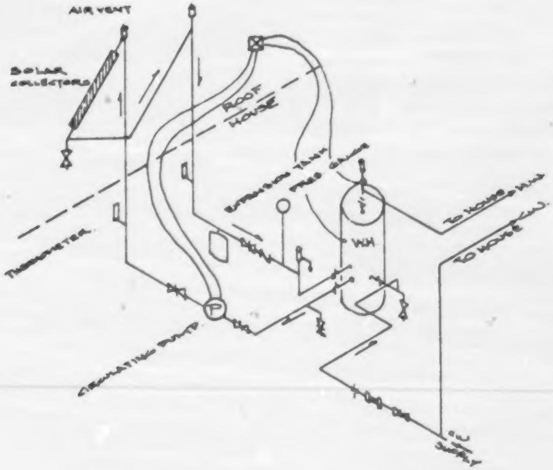


PROJECT INFORMATION

BUILDER: Yeonas Co.
DESIGNERS ARCHITECT: Yeonas Co.
ENGINEER: McCombs Solar Co.
LOCATION: Vienna, Virginia Latitude 38° 5' N.
HOUSING TYPE: One Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 4,224 **COOLING** 800 hrs.
AVE. TEMP. WINTER 30 **SUMMER** 70°F.
HORIZ. INSOLATION JAN. 175 **JUNE** 555 Ly.

BUILDING DESCRIPTION

The project outfits one new, single family detached dwellings with solar domestic hot water systems. The solar collectors are mounted on a separate structural frame attached to the house sloping south-facing roof. The frame tilts the collector for year round optimum solar radiation collection.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING____ **COOLING**____ **DHW** X

COLLECTOR: 21 square feet liquid-cooled flat-plate manufactured by Sunworks.

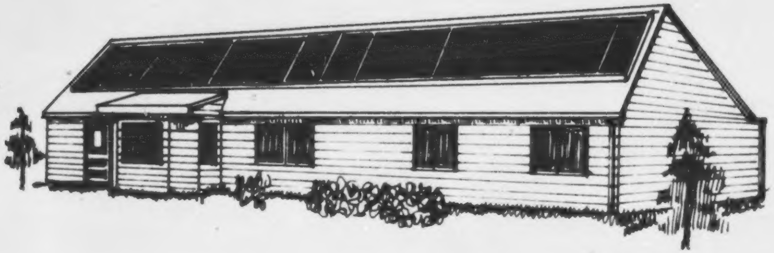
STORAGE: 65 gallon tank of a conventional water heater stores preheated water from the collector.

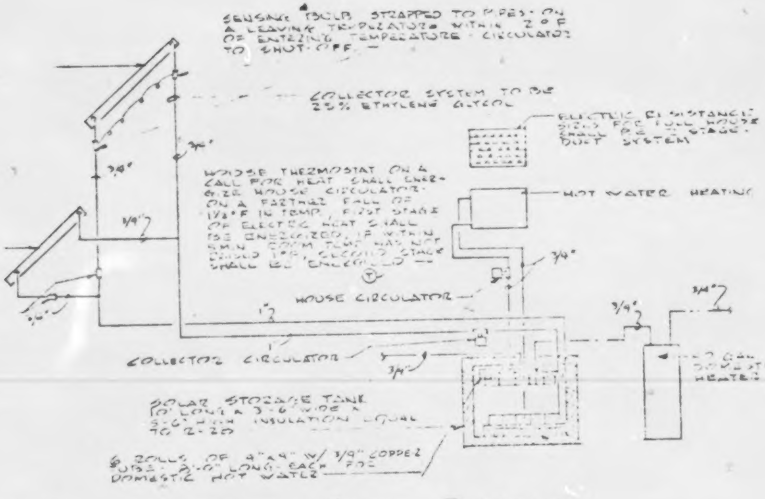
DISTRIBUTION: A copper coil within the storage tank preheats the domestic hot water supply as heated water from the collector circulates through the coil.

AUXILIARY ENERGY SYSTEM: Electric water heater. A conventional water heater with an auxiliary 4.5 KW electric heating element in the tank supplements the preheating system.

DOMESTIC HOT WATER SYSTEM: See collector, storage, distribution, and auxiliary for details.

COOLING: Not applicable.




SENSING BULB STRAPPED TO PIPES · ON A LEAVING TEMPERATURE WITHIN 2°F OF ENTERING TEMPERATURE · CIRCULATOR TO SHUT-OFF —
COLLECTOR SYSTEM TO BE 25% ETHYLENE GLYCOL
ELECTRIC RESISTANCE SIZED FOR FULL HOUSE SHALL BE 2 STAGE · DUCT SYSTEM
3/4"
3/4"
3/4"
HOUSE THERMOSTAT ON A CALL FOR HEAT SHALL ENERGIZE HOUSE CIRCULATOR · ON A FURTHER FALL OF 1½°F IN TEMP, FIRST STAGE OF ELECTRIC HEAT SHALL BE ENERGIZED, IF WITHIN 5 MIN ROOM TEMP HAS NOT RISEN 1°F, SECOND STAGE SHALL BE ENERGIZED —
HOT WATER HEATING
3/4"
HOUSE CIRCULATOR
1½"
3/4"
3/4"
1"
COLLECTOR CIRCULATOR
3/4"
40 GAL DOMESTIC HEATER
SOLAR STORAGE TANK 10' LONG x 3'-6" WIDE x 5'-6" HIGH INSULATION EQUAL TO R-20
6 ROLLS OF 4"x4" W/ 3/4" COPPER TUBE · 2'-0" LONG · EACH FOR DOMESTIC HOT WATER

SOLAR COLLECTOR PIPING DIAGRAM
NO SCALE

PROJECT INFORMATION

BUILDER: Sir Galahad Company
DESIGNERS ARCHITECT: Arthur Konikoff
ENGINEER: Solar One Ltd.
LOCATION: Virginia Beach, VA Latitude 37°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 3,542 **COOLING** 1,100 hrs.
AVE. TEMP. **WINTER** 40 **SUMMER** 75°F.
HORIZ. INSOLATION **JAN.** 200 **JUNE** 600 Ly.

BUILDING DESCRIPTION

The project consists of two-story single family detached dwelling integrated with a solar heating and domestic hot water preheating system. The roof-mounted collectors and a basement storage tank provide solar heat to the 1,896 square foot home. The contemporary wood frame home uses brick, cedar shingles, and wood siding for the exterior. Added floor, wall and ceiling insulation reduces infiltration and decreases heat loss.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ___ **DHW** X

COLLECTOR: 624 square feet liquid-cooled flat-plate manufactured by Revere. A copper absorber is located below two glass cover sheets.

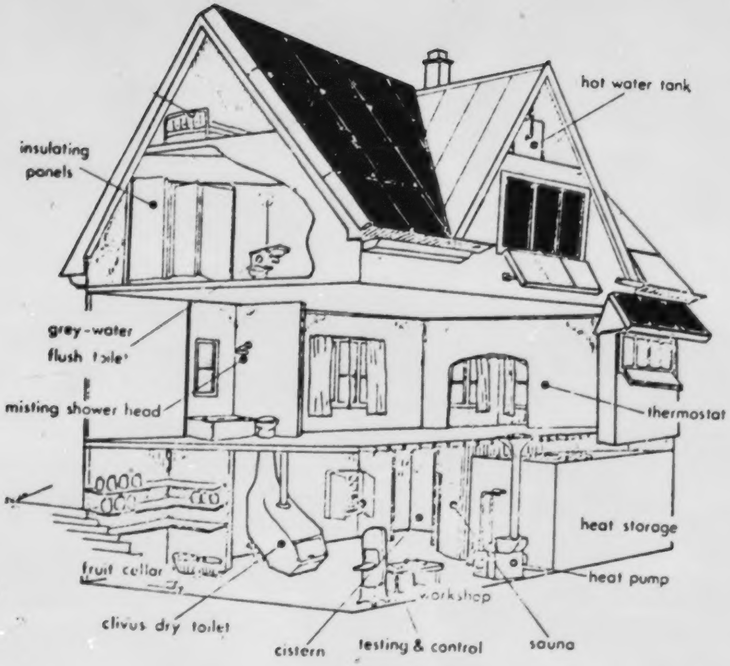
STORAGE: 1,250 gallons of water within an insulated welded rectangular steel tank located in the basement. Water is circulated through the collectors, heated, and stored in the tank. No heat exchanger is used.

DISTRIBUTION: Forced air. Heated water from the storage tank is pumped through copper coils in the ductwork. Air is blown over the coils, heated and distributed by ducts to the living spaces.

AUXILIARY ENERGY SYSTEM: Electric heating elements located in the primary supply duct provide total or supplemental heat as required.

DOMESTIC HOT WATER SYSTEM: Domestic hot water is preheated as it passes through the central storage tank. The preheated water is stored in the tank of a conventional water heater.

COOLING: Natural ventilation.


hot water tank
insulating panels
grey-water flush toilet
misting shower head
thermostat
heat storage
heat pump
fruit cellar
workshop
clivus dry toilet
cistern
testing & control
sauna

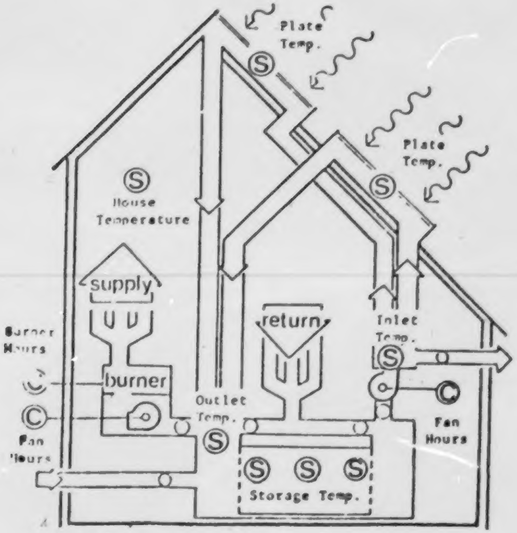


Plate Temp.
Plate Temp.
S
House Temperature
supply
return
Inlet Temp.
Burner Hours
burner
Outlet Temp.
Fan Hours
Fan Hours
Storage Temp.

PROJECT INFORMATION

BUILDER: University of Wisconsin-Milwaukee
DESIGNERS ARCHITECT: School of Architecture
ENGINEER: School of Engineering
LOCATION: Milwaukee, Wisconsin Latitude 42° 57' N
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS **HEATING** 7,449 **COOLING** 350 hrs.
AVE. TEMP. **WINTER** 20 **SUMMER** 65
HORIZ. INSOLATION **JAN.** 100 **JUNE** 500

BUILDING DESCRIPTION

The project involves the rehabilitation of an existing single family dwelling and the adaptation of the dwelling design for solar heating and domestic water heating. The two story wood framed house has a floor area of 2,400 square feet. Numerous energy conserving techniques include: additional wall and roof insulation; rain water collection system connected to a cistern for use in water closet flushing; enlarged south-facing windows to increase solar heat gain during the winter, combined with insulated shutters and panels to reduce heat loss and infiltration in the evenings or on sunless days; and the use of large overhangs to shield south-facing windows from summer solar heat gain.

SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 600 square foot air-cooled flat-plate manufactured by Solaron Corporation with reflective radiation gain from roof and catwalk surfaces; south-facing windows. Domestic hot water is heated by a separate 55 square foot liquid-cooled flat-plate collector.

STORAGE: 22 tons of one to two inch diameter rocks within an 8' x 15' x 5' concrete block storage bin in the basement. The storage bin is insulated with three to five inch polyurethane applied to the exterior.

DISTRIBUTION: Forced air, two stage thermostat with manual damper repositioned for seasonal changeover; natural radiation and convection.

AUXILIARY ENERGY SYSTEM: Gas furnace, between storage and distribution ducts provides supplemental heating during periods of extreme cold or cloudiness.

DOMESTIC HOT WATER SYSTEM: 55 square foot liquid-cooled flat-plate collector (Grumman Sunstream) preheats domestic hot water by a heat exchanger in a tank in the attic before passing to a conventional water heater.

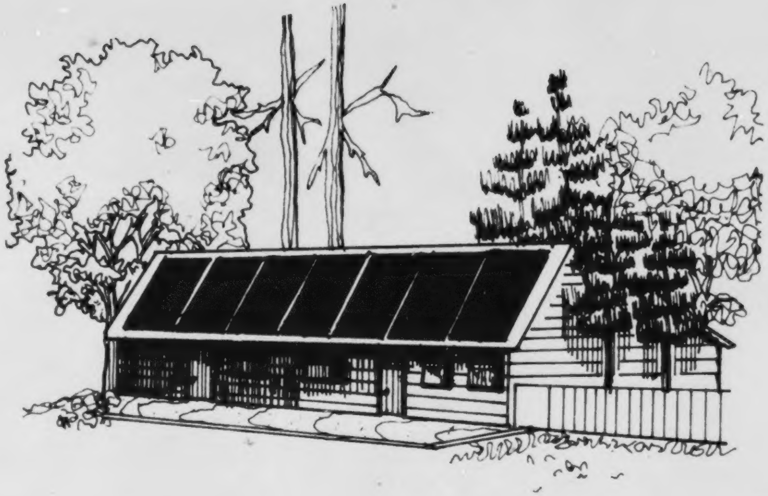
COOLING: Natural ventilation.

PROJECT INFORMATION

BUILDER: Friedman, Rosen, and Zien
DESIGNERS ARCHITECT: Herbert Zien
ENGINEER: Herbert Zien
LOCATION: Summit, Wisconsin Latitude 43°N.
HOUSING TYPE: Single Family Detached
CLIMATIC DATA: DEGREE DAYS HEATING 7,444 **COOLING** 460 hrs.
AVE. TEMP. WINTER 20 **SUMMER** 65°F.
HORIZ. INSOLATION JAN. 150 **JUNE** 510 Ly.

BUILDING DESCRIPTION

The project is an application of solar energy to the space heating and domestic hot water needs of a single family detached dwelling. The living spaces total 1,398 square feet. The contemporary wood frame building is simply detailed and compact in shape. Roof-mounted collectors supply a basement storage tank. The project illustrates an innovative concept for the integration of a heat pump with a solar energy system.



SOLAR ENERGY SYSTEM

SOLAR APPLICATION: HEATING X **COOLING** ____ **DHW** X

COLLECTOR: 858 square feet air-cooled flat-plate manufactured by Zien. The air collector passes the air over the black painted, galvanized steel absorber twice.

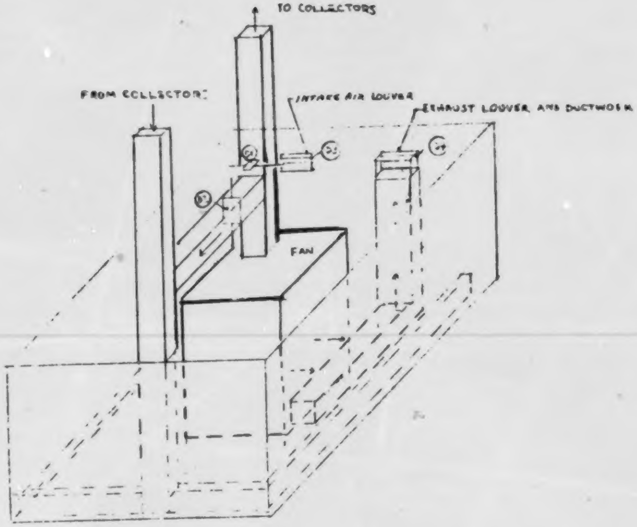
STORAGE: 40 tons of 1½" diameter rocks located in the basement within a "U" shaped rock bin with a heat pump in the center. Domestic hot water is stored in a 150 gallon preheat tank.

DISTRIBUTION: Forced air. The heat pump fan circulates air over heated rocks in storage. The warmed air enters ducts around the storage bin and is distributed to the occupied spaces.

AUXILIARY ENERGY SYSTEM: Two 4 kw electric heaters are built into the heat pump which is used to distribute solar heated air. A 6Kw heater is back-up in case of compressor failure.

DOMESTIC HOT WATER SYSTEM: A copper heat exchange coil in the ductwork of a separate 100 square foot one-pass air collector transfers heat from air to water for storage in the preheat tank.

COOLING: Solar storage assisted heat pump and natural ventilation.

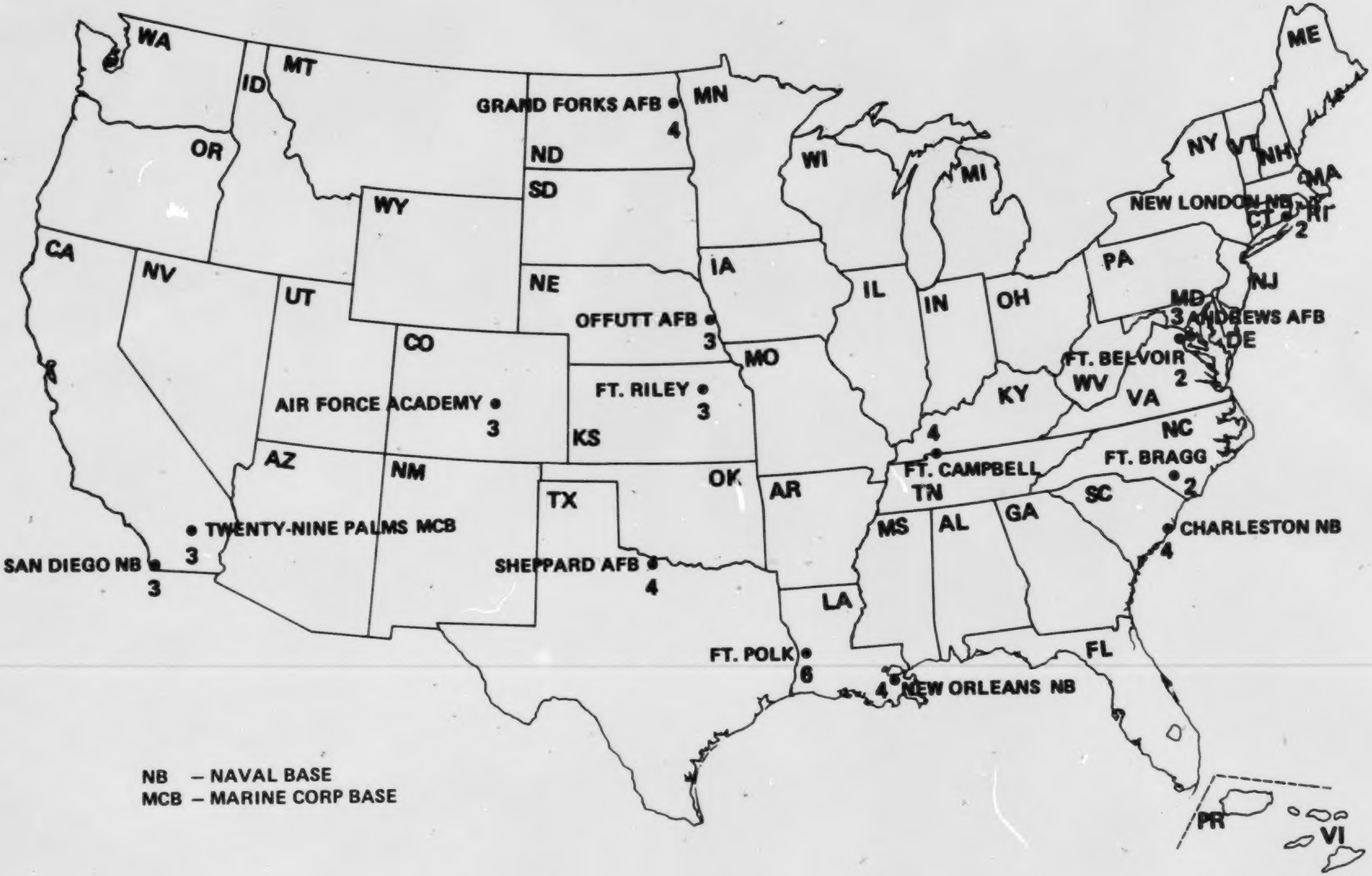


SECTION IV

RESIDENTIAL DEMONSTRATION PROGRAM FEDERAL BUILDINGS

240

RESIDENTIAL DEMONSTRATION PROGRAM
FEDERAL BUILDING UNITS


WA
ID
MT
GRAND FORKS AFB ● 4
MN
ME
OR
ND
WI
MI
NY
VT
NH
MA
SD
WY
NEW LONDON NB ● 2
CT
RI
CA
NV
UT
NE
IA
PA
NJ
OFFUTT AFB ● 3
IL
IN
OH
MD
3 ANDREWS AFB
DE
CO
MO
FT. BELVOIR 2
WV
VA
FT. RILEY ● 3
KY
AIR FORCE ACADEMY ● 3
KS
4
FT. CAMPBELL
NC
FT. BRAGG ● 2
AZ
NM
OK
AR
TN
SC
TX
GA
MS
AL
● TWENTY-NINE PALMS MCB 3
CHARLESTON NB 4
SAN DIEGO NB ● 3
SHEPPARD AFB ● 4
LA
FT. POLK ● 6
FL
4 NEW ORLEANS NB
NB – NAVAL BASE
MCB – MARINE CORP BASE
PR
VI

SECTION IV RESIDENTIAL DEMONSTRATION PROGRAM
FEDERAL BUILDINGS

PAGE	STATE	LOCATION	OWNER/ BUILDER	NUMBER OF UNITS	BUILDING TYPE	SOLAR APPLICATION	
120	CALIFORNIA	San Diego NB	Navy	3	MF	H	HW
123		Twenty-Nine Palms MCB	Navy	3	SFD,MF	H	HW
126	COLORADO	Air Force Academy	Air Force	3	MF	H	HW
129	CONNECTICUT	New London NB	Navy	2	MF	H	HW
131	KANSAS	Ft. Riley	Army	3	SFD	H	HW
134	KENTUCKY	Ft. Campbell	Army	4	MF	H	HW
138	LOUISIANA	New Orleans NB	Navy	4	MF	H	HW
142		Ft. Polk	Army	6	MF	H	HW
145	MARYLAND	Andrews AFB	Air Force	3	SFD	H	HW
148	NEBRASKA	Offutt AFB	Air Force	3	SFD	H	HW
151	NORTH CAROLINA	Ft. Bragg	Army	2	MF	H	HW
153	NORTH DAKOTA	Grand Forks AFB	Air Force	4	SFD	H	HW
157	SOUTH CAROLINA	Charleston NB	Navy	4	MF	H	HW
159	TEXAS	Sheppard AFB	Air Force	4	SFD	H	HW
163	VIRGINIA	Ft. Belvoir	Army	2	MF	H	HW

KEY

SFD	Single Family Detached
SFA	Single Family Attached
MF	Multi Family
H	Heating
C	Cooling
HW	Hot Water

243

244

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

Area: 1623 sq.ft.(total); 1456(conditioned)

Location: San Diego, California

Latitude: 33°N

Climatic Data

Degree Days	Heating	1574	Cooling	1500
Avg. Temp. (°F)	Winter	57	Summer	65
Avg. Insol.(Ly/d)	Winter	353	Summer	541

SOLAR ENERGY SYSTEM

Application Heating 95% Cooling 0% Hot Water 95%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 216

Manufacturer: Honeywell, Inc.

Storage

Type: Water

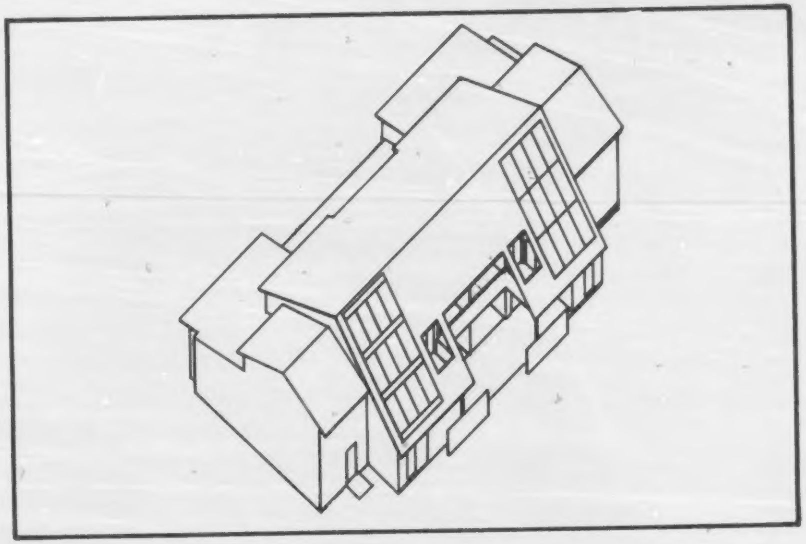
Capacity: 84 cu.ft.

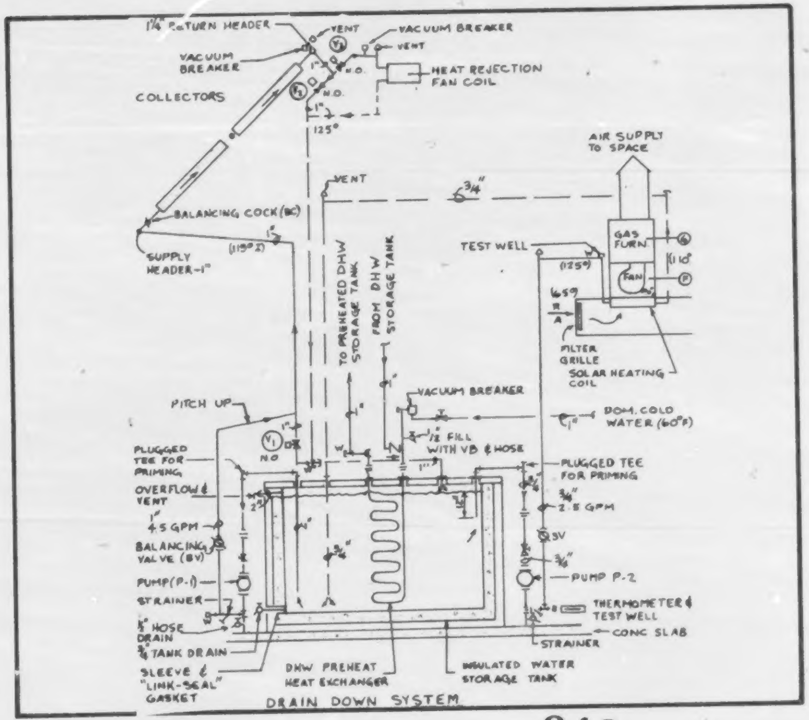
Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid and air in a hot-dry climate.

215




1¼" RETURN HEADER
VENT
V2
VACUUM BREAKER
VENT
VACUUM BREAKER
1"
N.O.
HEAT REJECTION FAN COIL
V3
N.O.
COLLECTORS
1"
125°
AIR SUPPLY TO SPACE
VENT
¾"
BALANCING COCK (BC)
1½"
(119°F)
SUPPLY HEADER-1"
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
TEST WELL
GAS FURN.
(125°)
110°
FAN
65°
R A
FILTER GRILLE
SOLAR HEATING COIL
PITCH UP
VACUUM BREAKER
DOM. COLD WATER (60°F)
1"
V1
NO
½" FILL WITH VB & HOSE
1"
PLUGGED TEE FOR PRIMING
PLUGGED TEE FOR PRIMING
OVERFLOW & VENT
2"
¾"
2.5 GPM
1"
4.5 GPM
BALANCING VALVE (BV)
BV
¾"
PUMP (P-1)
PUMP P-2
STRAINER
THERMOMETER & TEST WELL
½" HOSE DRAIN
CONC SLAB
STRAINER
¾" TANK DRAIN
SLEEVE & "LINK-SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK
DRAIN DOWN SYSTEM

216

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

Area: 1623 sq.ft.(total); 1456(conditioned)

Location: San Diego, California

Latitude: 33°N

Climatic Data

Degree Days	Heating	1574	Cooling	1500
Avg. Temp. (°F)	Winter	57	Summer	65
Avg. Insol.(Ly/d)	Winter	353	Summer	541

SOLAR ENERGY SYSTEM

Application Heating 79% Cooling 0% Hot Water 90%

Collector

Type: Air flat-plate

Area (sq. ft.): 234

Manufacturer: Solaron Corp

Storage

Type: Rock

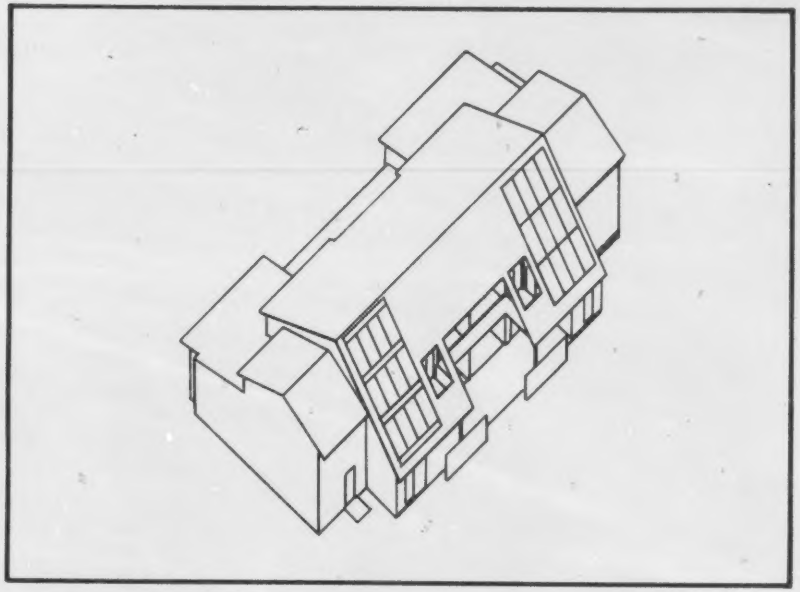
Capacity: 253 cu.ft.

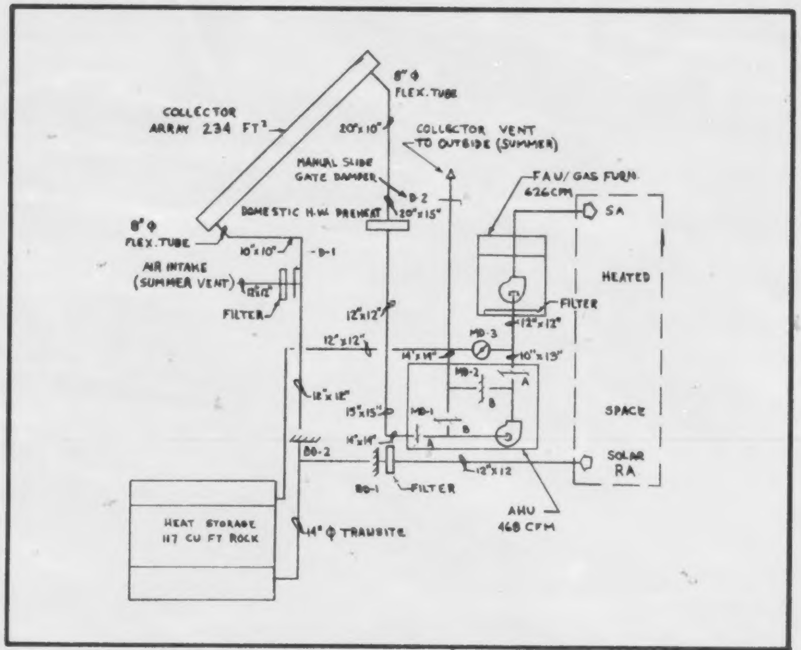
Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, and air in a hot-dry climate.

247




8" Φ
FLEX. TUBE
COLLECTOR
ARRAY 234 FT²
20"x10"
COLLECTOR VENT
TO OUTSIDE (SUMMER)
MANUAL SLIDE
GATE DAMPER
D-2
FAU/GAS FURN.
626CFM
DOMESTIC H.W. PREHEAT
20"x15"
SA
8" Φ
FLEX. TUBE
10"x10"
D-1
AIR INTAKE
(SUMMER VENT)
12"x12"
FILTER
HEATED
FILTER
12"x12"
12"x12"
MD-3
12"x12"
14"x14"
10"x13"
MD-2
A
B
12"x12"
15"x15"
MD-1
B
SPACE
14"x14"
A
BD-2
SOLAR
RA
12"x12
BD-1
FILTER
AHU
468 CFM
HEAT STORAGE
117 CU FT ROCK
14" Φ TRANSITE

248

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1623 sq.ft(total); 1456(conditioned)

Location: San Diego, California

Latitude: 33°N

Climatic Data

Degree Days	Heating	1574	Cooling	1500
Avg. Temp. (°F)	Winter	57	Summer	65
Avg. Insol.(Ly/d)	Winter	353	Summer	541

SOLAR ENERGY SYSTEM

Application Heating 95% Cooling 0% Hot Water 95%

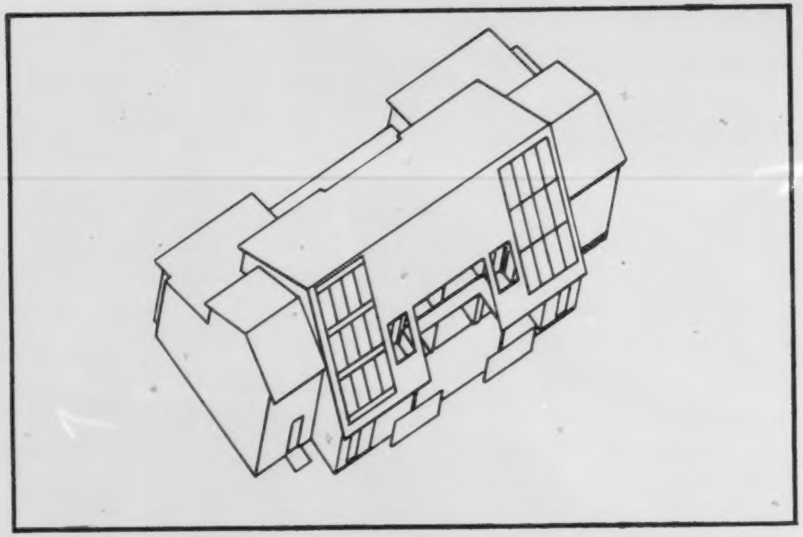
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 234
  Manufacturer: Revere Copper & Brass

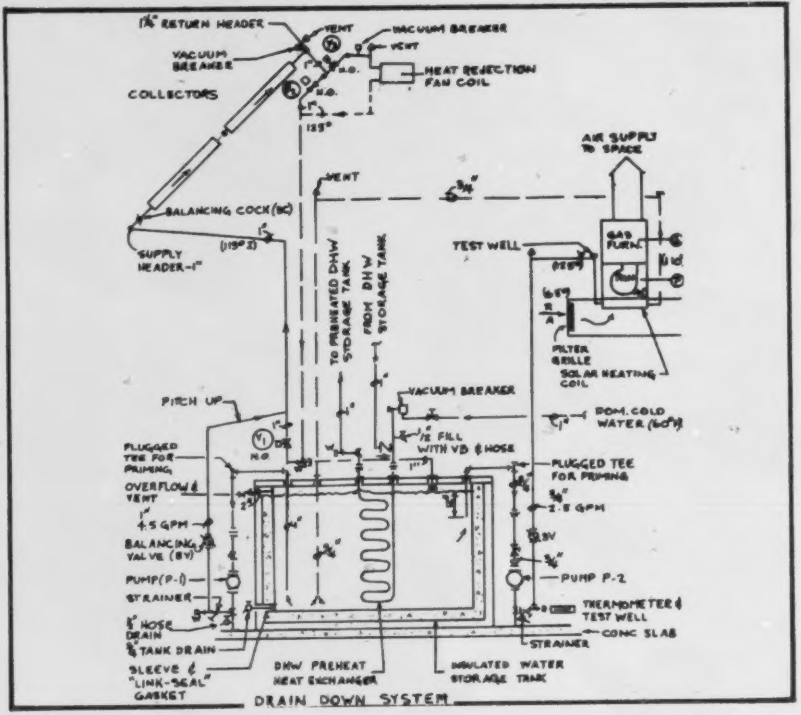
Storage
  Type: Water
  Capacity: 84 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid and air in a hot-dry climate.




1¼" RETURN HEADER
VENT
VACUUM BREAKER
VACUUM BREAKER
VENT
HEAT REJECTION FAN COIL
COLLECTORS
N.O.
N.O.
125°
AIR SUPPLY TO SPACE
VENT
¾"
BALANCING COCK(BC)
SUPPLY HEADER-1"
(119°Σ)
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
TEST WELL
GAS FURN.
FILTER GRILLE
SOLAR HEATING COIL
PITCH UP
VACUUM BREAKER
DOM. COLD WATER (60°F)
½" FILL WITH VB & HOSE
PLUGGED TEE FOR PRIMING
PLUGGED TEE FOR PRIMING
OVERFLOW & VENT
1" 4.5 GPM
2.5 GPM
BALANCING VALVE (BV)
BV
PUMP(P-1)
PUMP P-2
STRAINER
THERMOMETER & TEST WELL
¾" HOSE DRAIN
CONC SLAB
¾" TANK DRAIN
STRAINER
SLEEVE & "LINK-SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK

DRAIN DOWN SYSTEM

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

Area: 1968 sq.ft.(total); 1575(conditioned)

Location: Twenty-Nine Palms MCB, California

Latitude: 34°N

Climatic Data

Degree Days	Heating	2115	Cooling	2000
Avg. Temp. (°F)	Winter	50	Summer	71
Avg. Insol.(Ly/d)	Winter	353	Summer	541

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 0% Hot Water 90%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 288

Manufacturer: Sunworks, Inc.

Storage

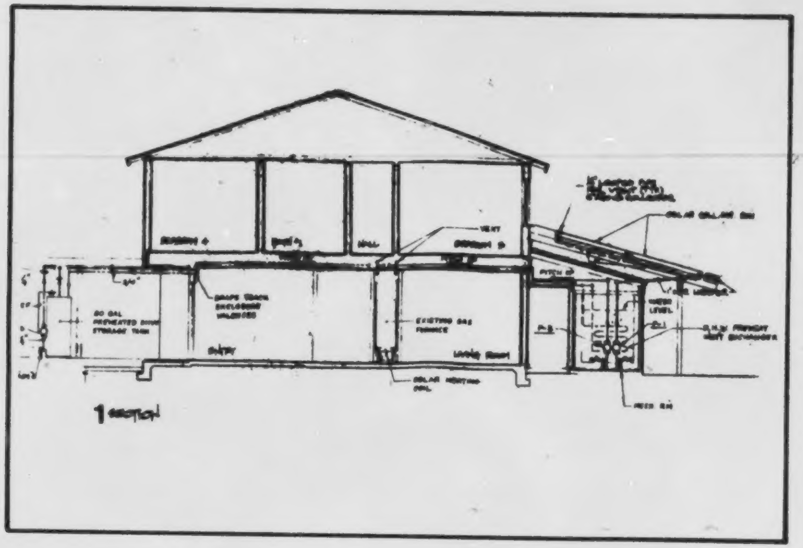
Type: Water

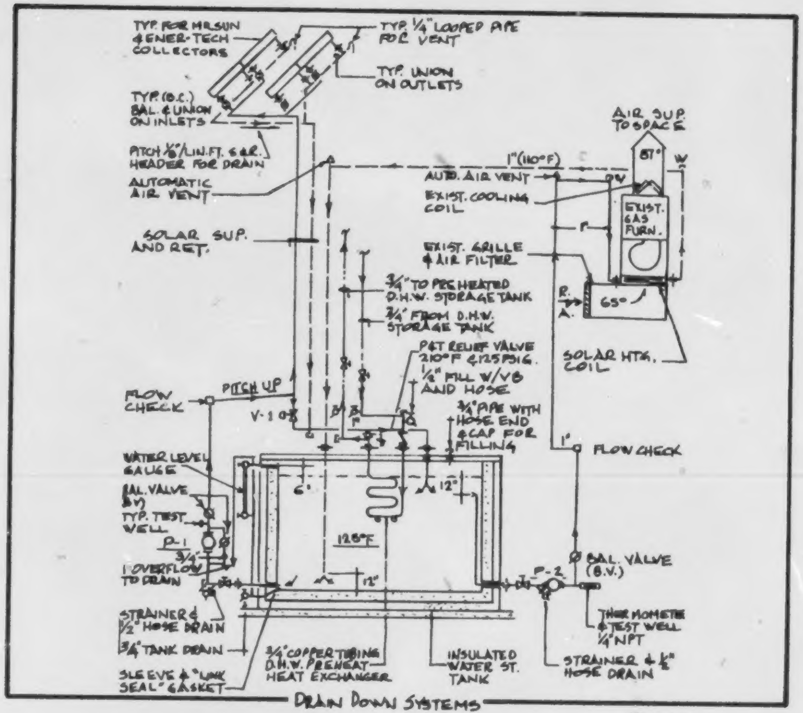
Capacity: 120 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the efficiency of flat-plate collectors at non-optimum tilts.


VENT
PITCH UP
WATER LEVEL
EXISTING GAS FURNACE
LIVING ROOM
ENTRY
SOLAR HEATING COIL
1 SECTION


TYP. FOR MR.SUN & ENER-TECH COLLECTORS
TYP. 1/4" LOOPED PIPE FOR VENT
TYP. UNION ON OUTLETS
TYP. (D.C.) BAL. & UNION ON INLETS
PITCH 1/8"/LIN.FT. S & R. HEADER FOR DRAIN
AUTOMATIC AIR VENT
1"(110°F)
AUTO. AIR VENT
EXIST. COOLING COIL
AIR SUP. TO SPACE
81°
W
EXIST. GAS FURN.
F
SOLAR SUP. AND RET.
EXIST. GRILLE & AIR FILTER
R. A.
65°
3/4" TO PREHEATED D.H.W. STORAGE TANK
3/4" FROM D.H.W. STORAGE TANK
P&T RELIEF VALVE 210°F & 125 PSIG.
1/2" FILL W/VB AND HOSE
SOLAR HTG. COIL
FLOW CHECK
PITCH UP
V-1
3/4" PIPE WITH HOSE END & CAP FOR FILLING
1"
FLOW CHECK
WATER LEVEL GAUGE
BAL. VALVE (BV)
TYP. TEST WELL
P-1
3/4"
1" OVERFLOW TO DRAIN
6"
12"
125°F
12"
BAL. VALVE (B.V.)
P-2
STRAINER & 1/2" HOSE DRAIN
3/4" TANK DRAIN
SLEEVE & "LINK SEAL" GASKET
3/4" COPPER TUBING D.H.W. PREHEAT HEAT EXCHANGER
INSULATED WATER ST. TANK
STRAINER & 1/2" HOSE DRAIN
THERMOMETER & TEST WELL 1/4" NPT

DRAIN DOWN SYSTEMS

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

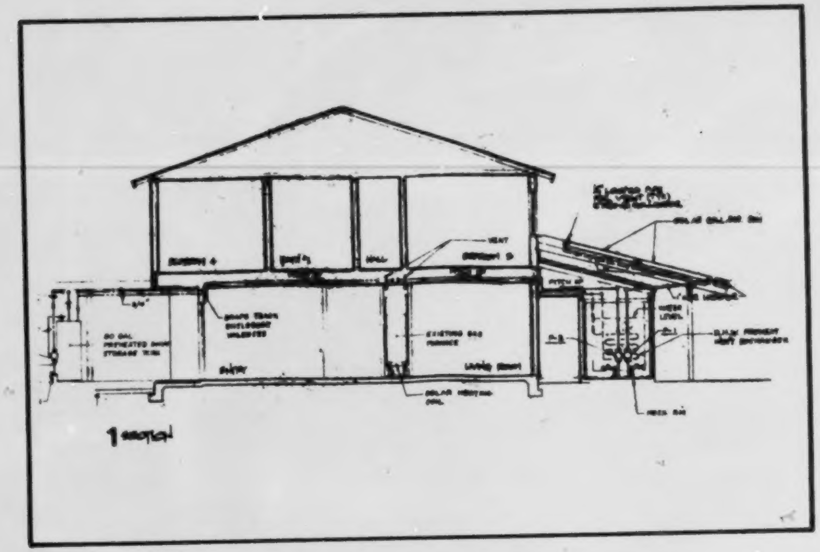
Building
  Type: Residential, rowhouse
  Area: 1968 sq.ft.(total); 1575(conditioned)

Location: Twenty-Nine Palms MCB, California

Latitude: 34°N

Climatic Data

Degree Days	Heating 2115	Cooling 2000
Avg. Temp. (°F)	Winter 50	Summer 71
Avg. Insol.(Ly/d)	Winter 353	Summer 541


VENT
1 SECTION

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 0% Hot Water 90%

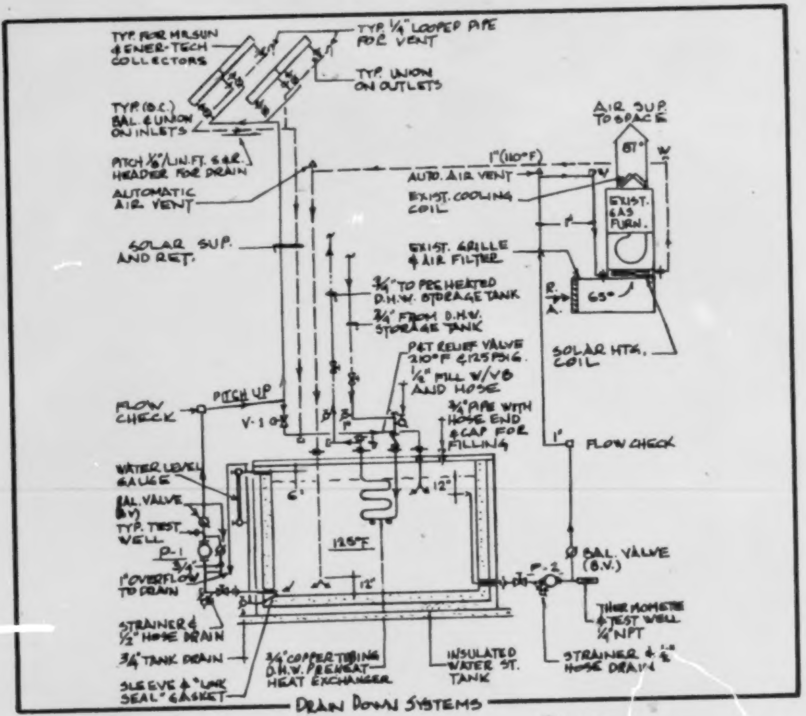
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 350
  Manufacturer: Energex

Storage
  Type: Water
  Capacity: 120 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the efficiency of flat-plate collectors at non-optimum tilts.


TYP. FOR MR.SUN & ENER-TECH COLLECTORS
TYP. 1/4" LOOPED PIPE FOR VENT
TYP. UNION ON OUTLETS
TYP. (B.C.) BAL. & UNION ON INLETS
PITCH 1/8"/LIN.FT. S&R. HEADER FOR DRAIN
AUTOMATIC AIR VENT
AIR SUP. TO SPACE
87°
W
1"(110°F)
AUTO. AIR VENT
EXIST. COOLING COIL
EXIST. GAS FURN.
1"
SOLAR SUP. AND RET.
EXIST. GRILLE & AIR FILTER
3/4" TO PREHEATED D.H.W. STORAGE TANK
3/4" FROM D.H.W. STORAGE TANK
R.A.
65°
SOLAR HTG. COIL
P&T RELIEF VALVE 210°F & 125 PSIG.
1/2" FILL W/VB AND HOSE
3/4" PIPE WITH HOSE END & CAP FOR FILLING
FLOW CHECK
PITCH UP
V-1
1"
FLOW CHECK
WATER LEVEL GAUGE
6"
12"
BAL. VALVE (B.V.)
TYP. TEST WELL
P-1
3/4"
125°F
1" OVERFLOW TO DRAIN
12"
BAL. VALVE (B.V.)
P-2
THERMOMETER & TEST WELL 1/4" NPT
STRAINER & 1/2" HOSE DRAIN
3/4" TANK DRAIN
SLEEVE & "LINK SEAL" GASKET
3/4" COPPER TUBING D.H.W. PREHEAT HEAT EXCHANGER
INSULATED WATER ST. TANK
STRAINER & 1/2" HOSE DRAIN
DRAIN DOWN SYSTEMS

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
- Type: Residential, rowhouse
- Area: 1968 sq.ft.(total); 1575(conditioned)

Location: Twenty-Nine Palms MCB, California

Latitude: 34°N

Climatic Data

Degree Days	Heating	2115	Cooling	2000
Avg. Temp. (°F)	Winter	50	Summer	41
Avg. Insol.(Ly/d)	Winter	353	Summer	541

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 0% Hot Water 90%

Collector
- Type: Liquid flat-plate
- Area (sq. ft.): 299
- Manufacturer: Mr. Sun

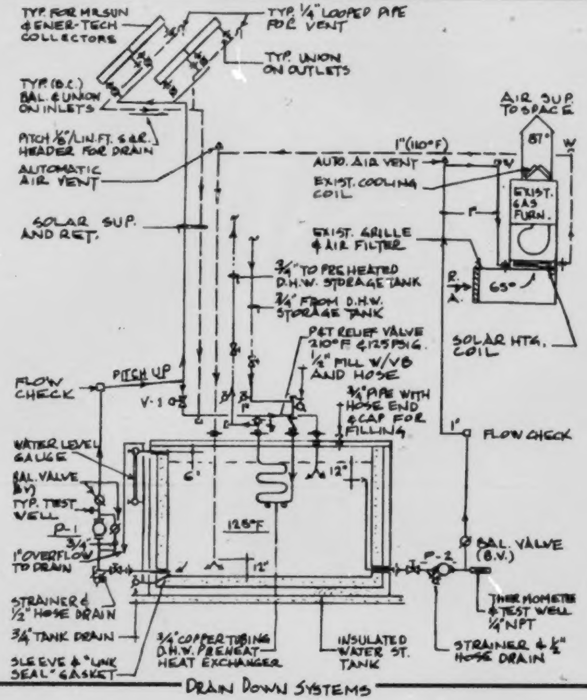
Storage
- Type: Water
- Capacity: 120 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the efficiency of flat-plate collectors at non-optimum tilts.

255


TYP. FOR MR SUN & ENER-TECH COLLECTORS
TYP. 1/4" LOOPED PIPE FOR VENT
TYP. UNION ON OUTLETS
TYP. (B.C.) BAL. & UNION ON INLETS
PITCH 1/8"/LIN.FT. S&R. HEADER FOR DRAIN
AUTOMATIC AIR VENT
1"(110°F)
AUTO. AIR VENT
EXIST. COOLING COIL
AIR SUP. TO SPACE
87°
W
EXIST. GAS FURN.
SOLAR SUP. AND RET.
EXIST. GRILLE & AIR FILTER
3/4" TO PREHEATED D.H.W. STORAGE TANK
3/4" FROM D.H.W. STORAGE TANK
R. A.
65°
P&T RELIEF VALVE 210°F & 125 PSIG.
1/2" MILL W/VB AND HOSE
SOLAR HTG. COIL
FLOW CHECK
PITCH UP
V-1
3/4" PIPE WITH HOSE END & CAP FOR FILLING
1"
FLOW CHECK
WATER LEVEL GAUGE
6"
12"
BAL. VALVE (BV)
TYP. TEST WELL
P-1
3/4"
125°F
1" OVERFLOW TO DRAIN
12"
BAL. VALVE (B.V.)
P-2
STRAINER & 1/2" HOSE DRAIN
THERMOMETER & TEST WELL 1/4" NPT
3/4" TANK DRAIN
3/4" COPPER TUBING D.H.W. PREHEAT HEAT EXCHANGER
INSULATED WATER ST. TANK
STRAINER & 1/2" HOSE DRAIN
SLEEVE & "LINK SEAL" GASKET
DRAIN DOWN SYSTEMS

256

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

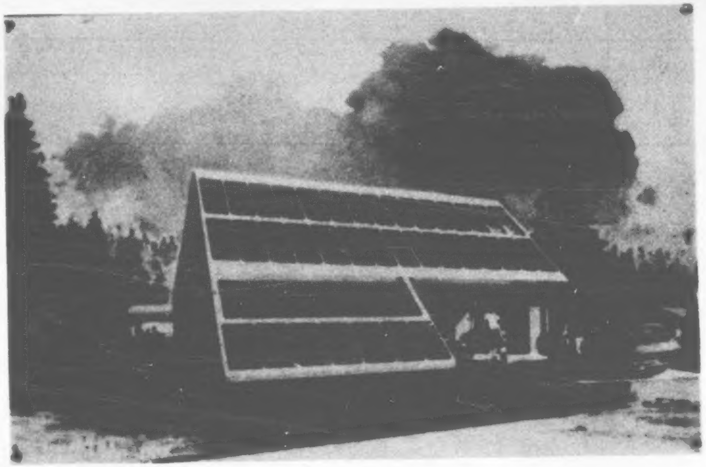
Building
- Type: Residential, single family
- Area: 1,238 sq.ft.

Location: Air Force Academy, Colorado

Latitude: 39°N

Climatic Data

Degree Days	Heating	6254	Cooling	500
Avg. Temp. (°F)	Winter	41	Summer	56
Avg. Insol.(Ly/d)	Winter	301	Summer	488



SOLAR ENERGY SYSTEM

Application Heating 81% Cooling 0% Hot Water 85%

Collector
- Type: Liquid flat-plate
- Area (sq. ft.): 742
- Manufacturer: Sunworks, Inc.

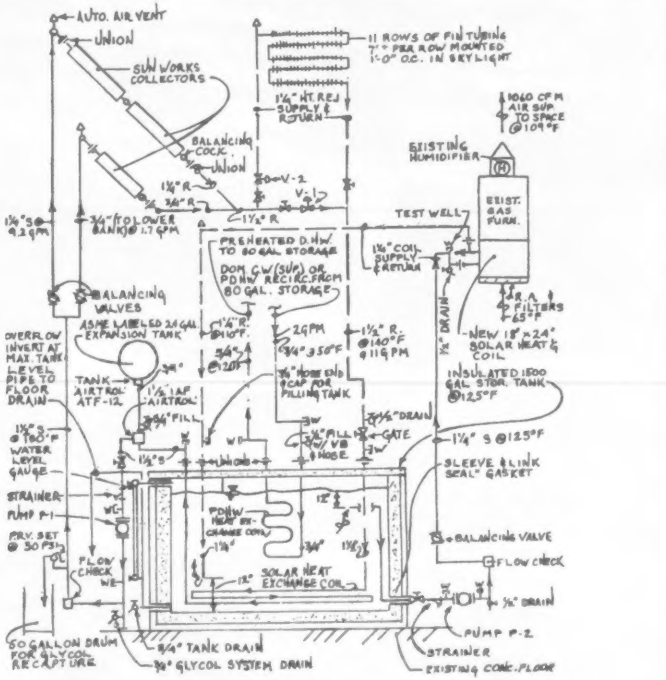
Storage
- Type: Water
- Capacity: 200 sq.ft.

Auxiliary System Type: Gas furnace w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of heat storage for air collectors utilizing existing basements.

257


AUTO. AIR VENT
UNION
SUN WORKS COLLECTORS
11 ROWS OF FIN TUBING 7' ± PER ROW MOUNTED 1'-0" O.C. IN SKYLIGHT
1¼" HT. REJ SUPPLY & RETURN
1060 CFM AIR SUP TO SPACE @109°F
BALANCING COCK
UNION
EXISTING HUMIDIFIER
H
V-2
V-1
1¼" R
¾" R
1½" R
TEST WELL
EXIST. GAS FURN.
1¼" S @ 9.2 gpm
¾" (TO LOWER BANK) @ 1.7 GPM
PREHEATED D.H.W. TO 80 GAL STORAGE
DOM. C.W. (SUP) OR PDHW RECIRC. FROM 80 GAL. STORAGE
1¼" COIL SUPPLY & RETURN
BALANCING VALVES
R.A. FILTERS 65°F
ASME LABELED 24 GAL. EXPANSION TANK
1¼" R. @110°F
2GPM
¾" 350°F
1½" R. @140°F @11GPM
½" DRAIN
NEW 18" × 24" SOLAR HEAT'G COIL
OVERFLOW INVERT AT MAX. TANK LEVEL PIPE TO FLOOR DRAIN
TANK AIRTROL ATF-12
¾" @120°F
¾"
1½" IAF AIRTROL
¾" HOSE END & CAP FOR FILLING TANK
INSULATED 1500 GAL STOR. TANK @125°F
¾" FILL
½" DRAIN
½" FILL W/ VB & HOSE
GATE
1½" S @180°F
WATER LEVEL GAUGE
1½" S
UNION
1¼" S @125°F
SLEEVE & LINK SEAL GASKET
STRAINER
PUMP P-1
PDHW HEAT EXCHANGE COIL
12"
P.R.V. SET @ 30 PSI
1¼"
¾"
1½"
BALANCING VALVE
FLOW CHECK
SOLAR HEAT EXCHANGE COIL
12"
FLOW CHECK
½" DRAIN
50 GALLON DRUM FOR GLYCOL RECAPTURE
¾" TANK DRAIN
¾" GLYCOL SYSTEM DRAIN
PUMP P-2
STRAINER
EXISTING CONC. FLOOR

258

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

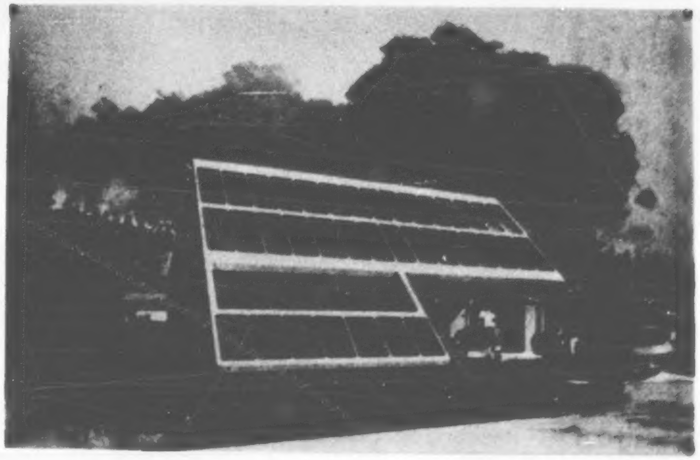
- Type: Residential, single family
- Area: 1,238 sq.ft.

Location: Air Force Academy, Colorado

Latitude: 39°N

Climatic Data

Degree Days	Heating 6254	Cooling 500
Avg. Temp. (°F)	Winter 41	Summer 56
Avg. Insol.(Ly/d)	Winter 301	Summer 488



SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 85%

Collector

- Type: Air flat-plate
- Area (sq. ft.): 768
- Manufacturer: Solaron Corp.

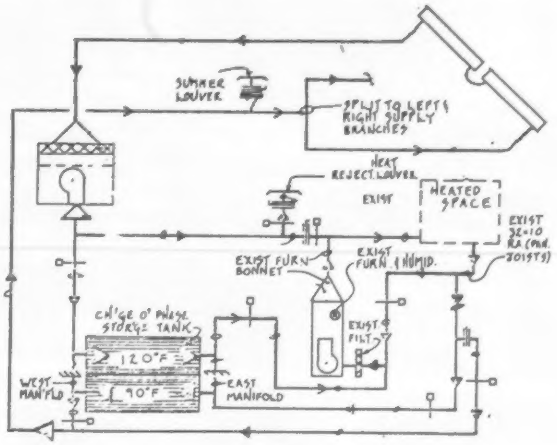
Storage

- Type: Rock
- Capacity: 600 sq.ft.

Auxiliary System Type: Gas furnace w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of heat storage for air collectors utilizing existing basements.


SUMMER LOUVER
SPLIT TO LEFT & RIGHT SUPPLY BRANCHES
HEAT REJECT. LOUVER
EXIST
HEATED SPACE
EXIST 32=10 RA (PAN. JOISTS)
EXIST FURN BONNET
EXIST FURN. & HUMID.
CH'GE O' PHASE STOR'G: TANK
120°F
90°F
EXIST FILT.
WEST MAN'FLD
EAST MANIFOLD

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, single family
  Area: 1,238 sq.ft.

Location: Air Force Academy, Colorado

Latitude: 39°N

Climatic Data

Degree Days	Heating	6254	Cooling	500
Avg. Temp. (°F)	Winter	41	Summer	56
Avg. Insol.(Ly/d)	Winter	301	Summer	488

SOLAR ENERGY SYSTEM

Application Heating 76% Cooling 0% Hot Water 85%

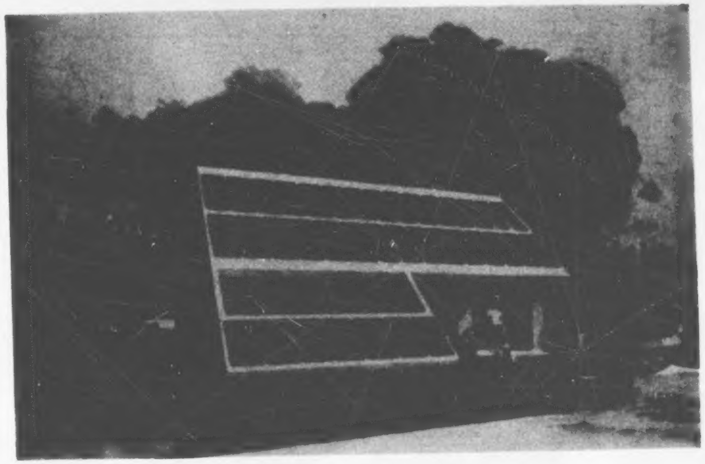
Collector
  Type: Air flat-plate
  Area (sq. ft.): 704
  Manufacturer: Solaron Corp.

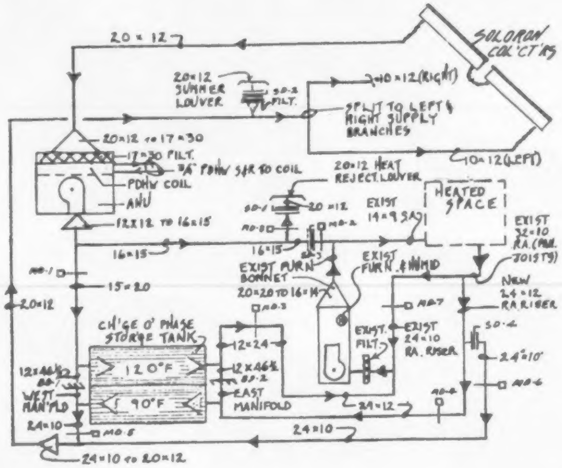
Storage
  Type: Change of phase
  Capacity: 636,000 Btu

Auxiliary System Type: Gas furnace w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of heat storage for air collectors utilizing existing basements.





SOLORON COL'CT'RS
20×12
20×12 SUMMER LOUVER
SO-3 FILT.
10×12(RIGHT)
SPLIT TO LEFT & RIGHT SUPPLY BRANCHES
10×12(LEFT)
20×12 to 17×30
17×30 FILT.
3/4" PDHW S&R TO COIL
PDHW COIL
AHU
12X12 TO 16×15
20×12 HEAT REJECT LOUVER
SO-1
20×12
MD-8
MD-2
EXIST 14×9 SA
HEATED SPACE
EXIST 32×10 RA (PAN. JOISTS)
16×15
16×15
SO-3
EXIST FURN BONNET
EXIST FURN. & HMD
20×20 TO 16×14
MD-1
15×20
20×12
MD-7
NEW 24×12 RA RISER
MD-3
CH'GE O' PHASE STOR'GE TANK
12×24
12×46½
SD-2
EAST MANIFOLD
120°F
90°F
12×46½
SD-1
WEST MAN'FLD
24×10
MD-5
EXIST. FILT.
EXIST 24×10 RA. RISER
SO-4
24×10
MD-6
MD-4
24×12
24×10
24×10 to 20×12

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 930 sq.ft.

Location: New London Naval Base, Connecticut

Latitude: 41°N

Climatic Data

Degree Days	Heating 6026	Cooling 1100
Avg. Temp. (°F)	Winter 43	Summer 68
Avg. Insol.(Ly/d)	Winter 236	Summer 431

SOLAR ENERGY SYSTEM

Application Heating 60% Cooling 0% Hot Water 65%

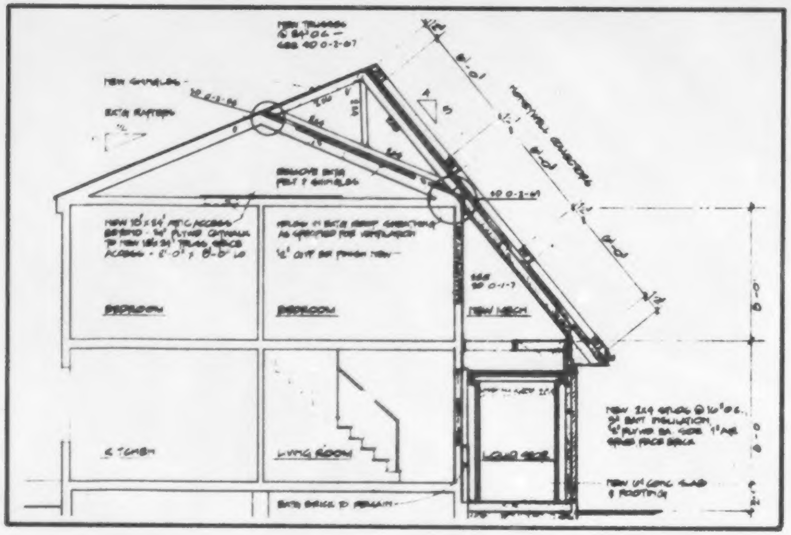
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 252
  Manufacturer: Honeywell, Inc.

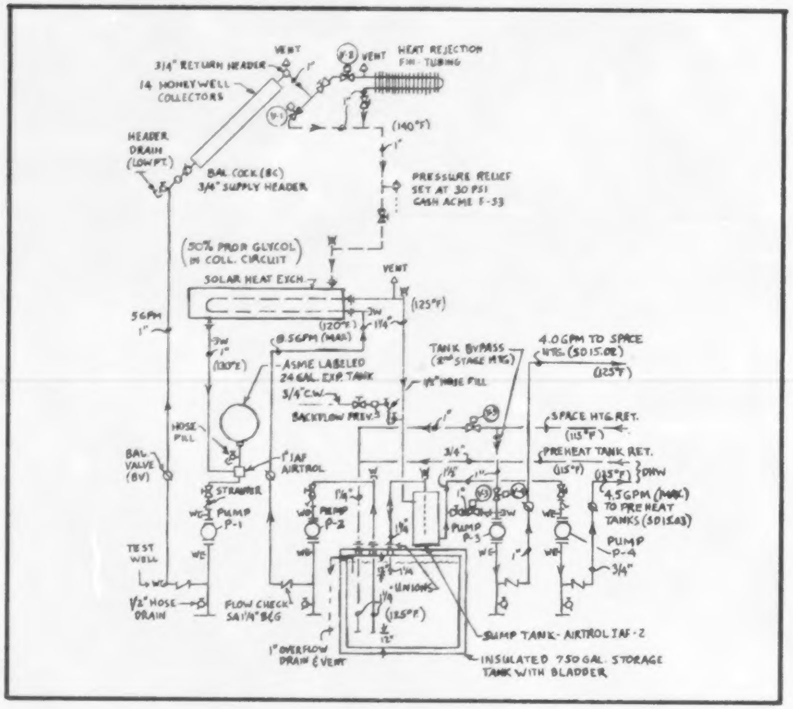
Storage
  Type: Water
  Capacity: 100 cu.ft.

Auxiliary System Type: Remote central hot water boiler

PROJECT DESCRIPTION

Objective(s): To compare retrofitting existing townhouses with existing single family houses.


NEW SHINGLES
EXIST. RAFTERS
HONEYWELL COLLECTORS
BEDROOM
BEDROOM
NEW MECH
KITCHEN
LIVING ROOM
EXIST. BRICK TO REMAIN


VENT
3/4" RETURN HEADER
14 HONEYWELL COLLECTORS
V-2
VENT
HEAT REJECTION FIN-TUBING
V-1
(140°F)
HEADER DRAIN (LOW PT.)
BAL. COCK (BC)
3/4" SUPPLY HEADER
PRESSURE RELIEF SET AT 30 PSI CASH ACME F-53
(50% PROP GLYCOL IN COLL. CIRCUIT)
SOLAR HEAT EXCH.
VENT
(125°F)
5GPM 1"
(120°F)
1 1/4"
8.5GPM (MAX)
(130°F)
ASME LABELED 24 GAL. EXP. TANK
3/4" C.W.
BACKFLOW PREV.
1 1/2" HOSE FILL
TANK BYPASS (2nd STAGE HTG)
4.0GPM TO SPACE HTG. (SD15.02)
(125°F)
SPACE HTG RET.
(115°F)
PREHEAT TANK RET.
(115°F)
(125°F)
DHW
HOSE FILL
BAL. VALVE (BV)
1" IAF AIRTROL
STRAINER
PUMP P-1
PUMP P-2
PUMP P-3
PUMP P-4
4.5GPM (MAX) TO PREHEAT TANKS (SD15.03)
3/4"
TEST WELL
1/2" HOSE DRAIN
FLOW CHECK SA 1 1/4" B&G
UNIONS
(125°F)
1" OVERFLOW DRAIN & VENT
SUMP TANK - AIRTROL IAF-2
INSULATED 750 GAL. STORAGE TANK WITH BLADDER

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, single family
  Area: 1,447 sq.ft.

Location: New London Naval Base, Connecticut

Latitude: 41°N

Climatic Data

Degree Days	Heating	6026	Cooling	1100
Avg. Temp. (°F)	Winter	43	Summer	68
Avg. Insol.(Ly/d)	Winter	236	Summer	431

SOLAR ENERGY SYSTEM

Application Heating 57% Cooling 0% Hot Water 65%

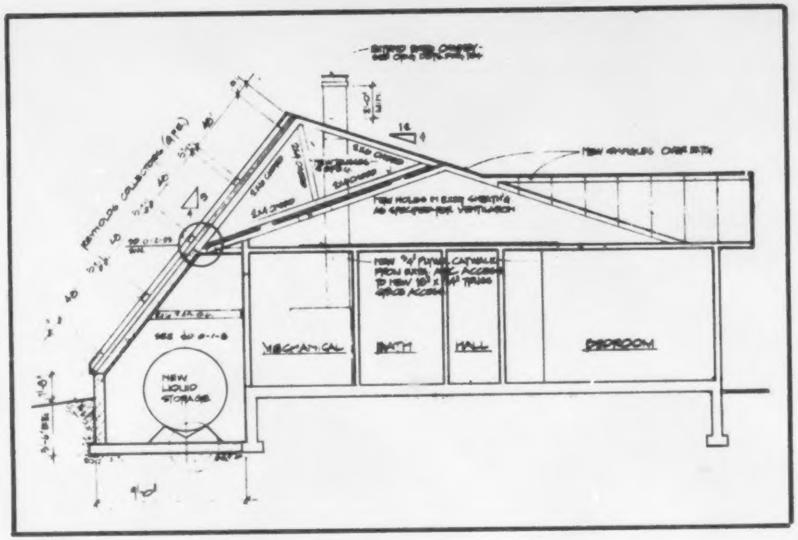
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 576
  Manufacturer: Reynolds

Storage
  Type: Water
  Capacity: 200 cu.ft.

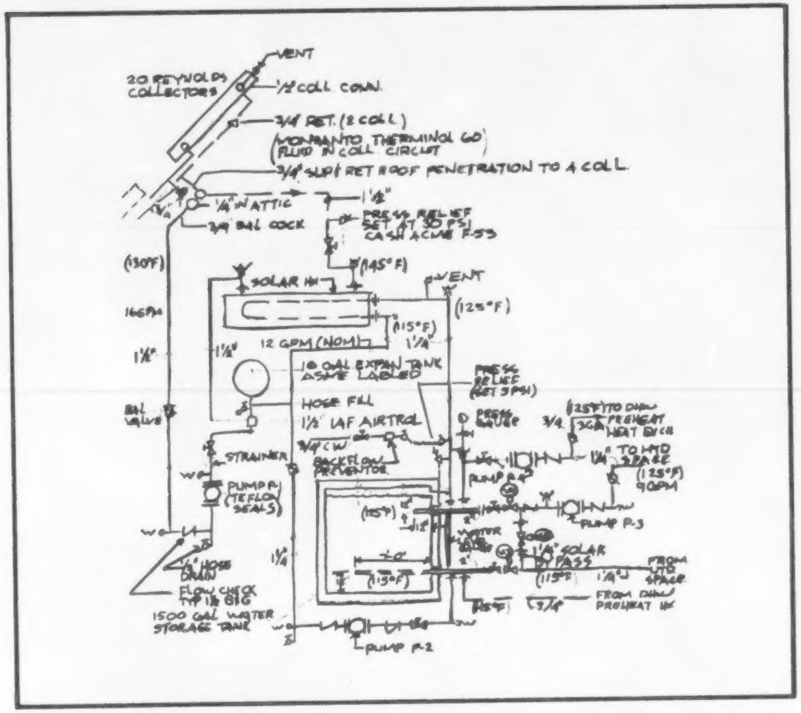
Auxiliary System Type: Oil hot water boiler w/radiation

PROJECT DESCRIPTION

Objective(s): To compare retrofitting existing townhouses with existing single family houses.



REYNOLDS COLLECTORS
NEW SHINGLES OVER BATH
16
4
NEW LIQUID STORAGE
MECHANICAL
BATH
HALL
BEDROOM
9'-0"

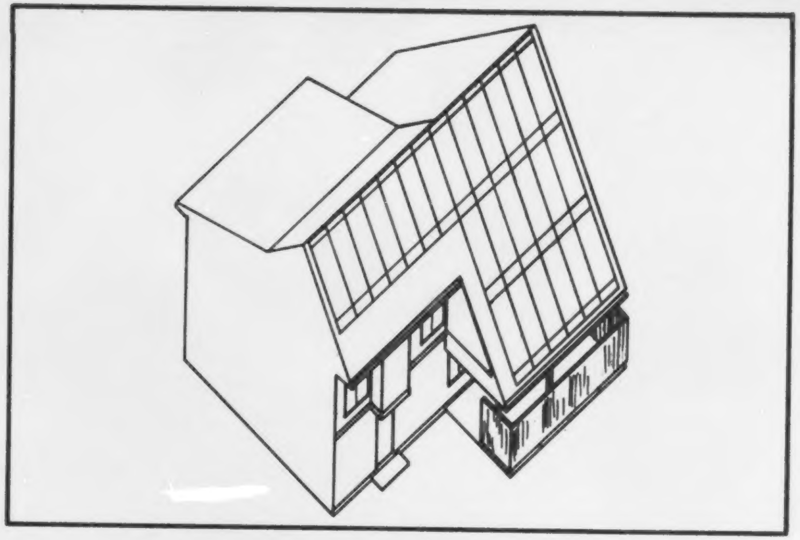


VENT
20 REYNOLDS COLLECTORS
1/2 COLL CONN.
3/4 RET. (2 COLL)
(MONSANTO THERMINOL 60 FLUID IN COLL CIRCUIT)
3/4 SUP/RET ROOF PENETRATION TO A COLL.
1/4" IN ATTIC
1 1/2"
3/4 BAL COCK
PRESS RELIEF SET AT 30 PSI CASH ACME F-55
(130°F)
(145°F)
SOLAR HX
VENT
(125°F)
16GPM
(115°F)
12 GPM (NOM)
1 1/4"
1 1/2"
1 1/2"
10 GAL EXPAN TANK ASME LABLED
PRESS RELIEF (SET 3 PSI)
HOSE FILL
BAL VALVE
1 1/2" IAF AIRTROL
PRESS GAUGE
3/4
(125°F) TO DHW PREHEAT HEAT EXCH
3GPM
3/4" CW
STRAINER
BACKFLOW PREVENTOR
1 1/4" TO HTD SPACE
PUMP P-4
(125°F) 9GPM
PUMP P-1 (TEFLON SEALS)
(115°)
PUMP P-3
WATER LEVEL GAUGE
1 1/4" SOLAR BYPASS
1 1/4
1/2" HOSE DRAIN
FLOW CHECK TYP 1 1/2 BIG
(115°F)
(115°F)
1 1/4"
FROM HTD SPACE
1500 GAL WATER STORAGE TANK
3/4
FROM DHW PREHEAT HX
PUMP P-2

PROJECT INFORMATION

Owner/Builder: Army
Contractor:
Operational Date: April 1977
Total Estimated ERDA Funds: To be determined
Building
  Type: Residential, rowhouse
  Area: 1,471 sq.ft.
Location: Fort Riley, Kansas
Latitude: 39°N
Climatic Data

Degree Days	Heating	5323	Cooling	1800
Avg. Temp. (°F)	Winter	42	Summer	70
Avg. Insol.(Ly/d)	Winter	266	Summer	457

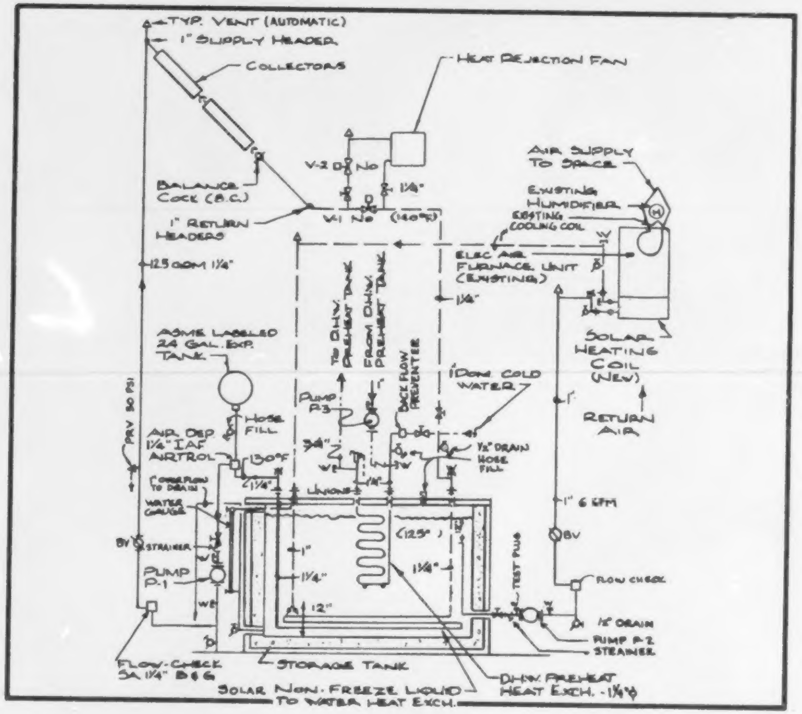


SOLAR ENERGY SYSTEM

Application Heating 62% Cooling 0% Hot Water 80%
Collector
  Type: Fixed flat-plate
  Area (sq. ft.): 525
  Manufacturer: Sunworks, Inc.
Storage
  Type: Water
  Capacity: 147 cu.ft.
Auxiliary System Type: Electric furnace

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of collector site-mounting with roof mounting.


TYP. VENT (AUTOMATIC)
1" SUPPLY HEADER
COLLECTORS
HEAT REJECTION FAN
V-2 NO
1¼"
BALANCE COCK (B.C.)
1" RETURN HEADERS
V-1 NO
(140°F)
AIR SUPPLY TO SPACE
EXISTING HUMIDIFIER
EXISTING COOLING COIL
ELEC AIR FURNACE UNIT (EXISTING)
125 GPM 1¼"
1¼"
TO D.H.W. PREHEAT TANK
FROM D.H.W. PREHEAT TANK
BACK FLOW PREVENTER
ASME LABELLED 24 GAL. EXP. TANK
1" DOM COLD WATER
SOLAR HEATING COIL (NEW)
RETURN AIR
PUMP P3
PRV 30 PSI
HOSE FILL
AIR DEP 1¼" IAF AIRTROL
130°F
¾"
½" DRAIN
HOSE FILL
OVERFLOW TO DRAIN
1¼"
UNIONS
1"
WATER GAUGE
1" 6 GPM
BV
STRAINER
(125°)
1"
1¼"
1¼"
BV
TEST PLUG
PUMP P-1
FLOW CHECK
12"
½" DRAIN
PUMP P-2
STRAINER
FLOW-CHECK SA 1¼" B&G
STORAGE TANK
SOLAR NON-FREEZE LIQUID TO WATER HEAT EXCH.
D.H.W. PREHEAT HEAT EXCH. - 1¼"

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,471 sq.ft.

Location: Fort Riley, Kansas

Latitude: 39°N

Climatic Data

Degree Days	Heating 5323	Cooling 1800
Avg. Temp. (°F)	Winter 42	Summer 70
Avg. Insol.(Ly/d)	Winter 266	Summer 457

SOLAR ENERGY SYSTEM

Application Heating 72% Cooling 0% Hot Water 80%

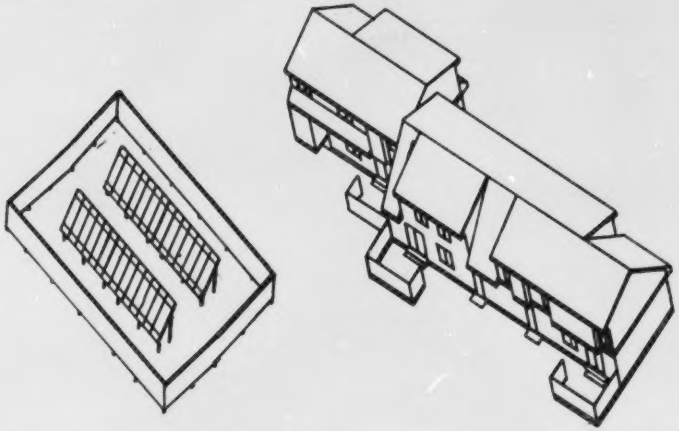
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 528
  Manufacturer: Unitspan

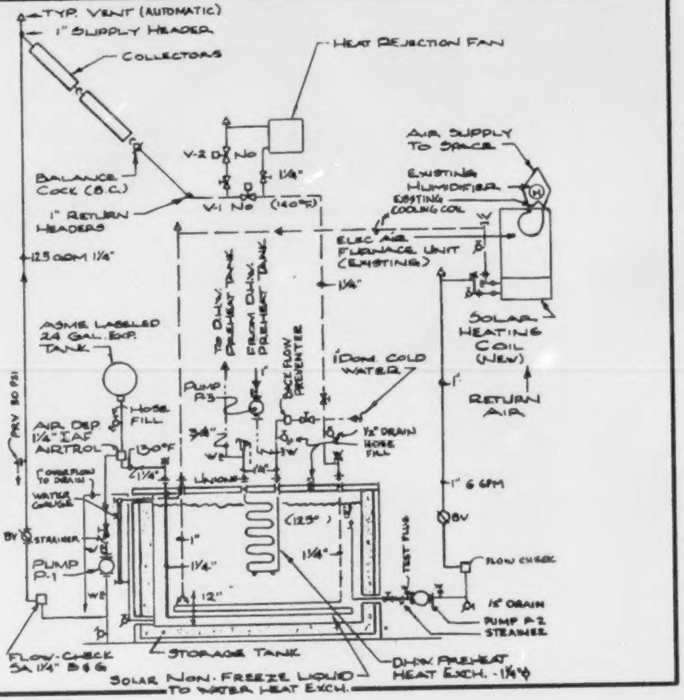
Storage
  Type: Water
  Capacity: 146 cu.ft.

Auxiliary System Type: Electric furnace

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of collector site-mounting with roof mounting.




TYP. VENT (AUTOMATIC)
1" SUPPLY HEADER
COLLECTORS
HEAT REJECTION FAN
V-2 D NO
1¼"
BALANCE COCK (B.C.)
1" RETURN HEADERS
V-1 NO
(140°F)
AIR SUPPLY TO SPACE
EXISTING HUMIDIFIER
EXISTING COOLING COIL
ELEC AIR FURNACE UNIT (EXISTING)
12.5 GPM 1¼"
1¼"
TO D.H.W. PREHEAT TANK
FROM D.H.W. PREHEAT TANK
BACK FLOW PREVENTER
1 DOM. COLD WATER
SOLAR HEATING COIL (NEW)
RETURN AIR
ASME LABELLED 24 GAL. EXP. TANK
PRV 30 PSI
HOSE FILL
PUMP P3
AIR DEP 1¼" IAF AIRTROL
130°F
¾"
1¼"
UNIONS
½" DRAIN
HOSE FILL
1" 6 GPM
OVERFLOW TO DRAIN
WATER GAUGE
(125°)
BV
STRAINER
1"
1¼"
1¼"
PUMP P-1
12"
TEST PLUG
FLOW CHECK
½" DRAIN
PUMP P-2
STRAINER
FLOW-CHECK 3A 1¼" B&G
STORAGE TANK
SOLAR NON-FREEZE LIQUID TO WATER HEAT EXCH.
D.H.W. PREHEAT HEAT EXCH. - 1¼"

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

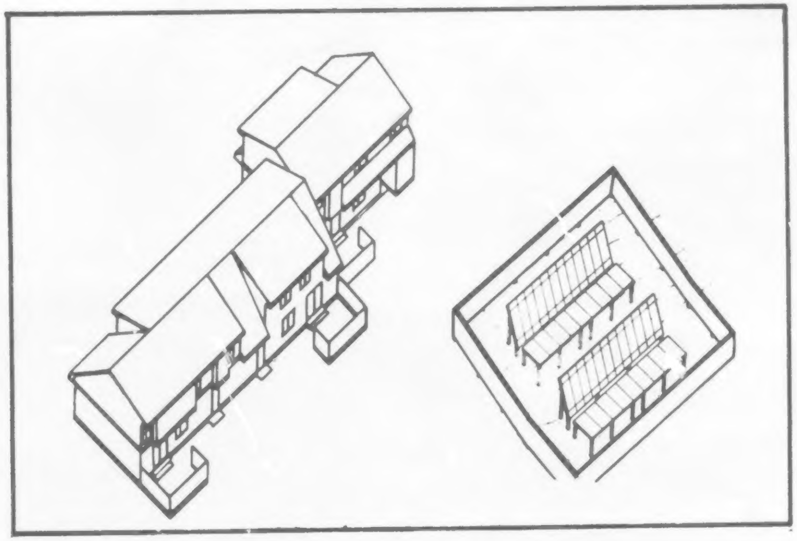
Building
- Type: Residential, rowhouse
- Area: 1838 sq.ft.(total; 1471(conditioned)

Location: Fort Riley, Kansas

Latitude: 39°N

Climatic Data

Degree Days	Heating	5323	Cooling	1800
Avg. Temp. (°F)	Winter	42	Summer	70
Avg. Insol.(Ly/d)	Winter	266	Summer	457



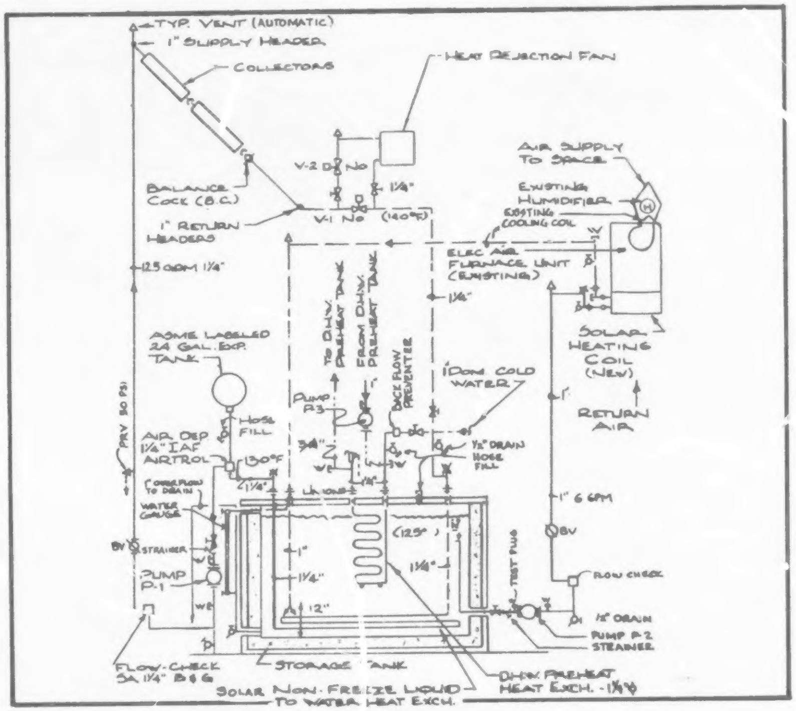
SOLAR ENERGY SYSTEM

Application Heating 59% Cooling 0% Hot Water 80%

Collector
- Type: Liquid flat-plate
- Area (sq. ft.): 501
- Manufacturer: Raypak

Storage
- Type: Water
- Capacity: 147 cu.ft.

Auxiliary System Type: Electric furnace


TYP. VENT (AUTOMATIC)
1" SUPPLY HEADER
COLLECTORS
HEAT REJECTION FAN
V-2 NO
1¼"
BALANCE COCK (B.C.)
V-1 NO (140°F)
1" RETURN HEADERS
AIR SUPPLY TO SPACE
EXISTING HUMIDIFIER
EXISTING COOLING COIL
ELEC AIR FURNACE UNIT (EXISTING)
12.5 GPM 1¼"
TO D.H.W. PREHEAT TANK
FROM D.H.W. PREHEAT TANK
BACK FLOW PREVENTER
1¼"
SOLAR HEATING COIL (NEW)
ASME LABELLED 24 GAL. EXP. TANK
1" DOM. COLD WATER
PUMP P3
RETURN AIR
PRV 30 PSI
HOSE FILL
AIR DEP 1¼" IAF AIRTROL
130°F
¾"
½" DRAIN
HOSE FILL
OVERFLOW TO DRAIN
1¼"
UNIONS
1" 6 GPM
WATER GAUGE
(125°)
BV
BV
STRAINER
1"
1¼"
TEST PLUG
PUMP P-1
1¼"
FLOW CHECK
12"
½" DRAIN
PUMP P-2
STRAINER
FLOW-CHECK SA 1¼" B&G
STORAGE TANK
D.H.W. PREHEAT HEAT EXCH. - 1¼"
SOLAR NON-FREEZE LIQUID TO WATER HEAT EXCH.

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of collector site-mounting with roof mounting.

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

Area: 1,503 sq.ft.

Location: Fort Campbell, Kentucky

Latitude: 36°N

Climatic Data

Degree Days	Heating	4279	Cooling	2000
Avg. Temp. (°F)	Winter	47	Summer	73
Avg. Insol.(Ly/d)	Winter	260	Summer	472

SOLAR ENERGY SYSTEM

Application Heating 76% Cooling 0% Hot Water 80%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 378

Manufacturer: Honeywell, Inc.

Storage

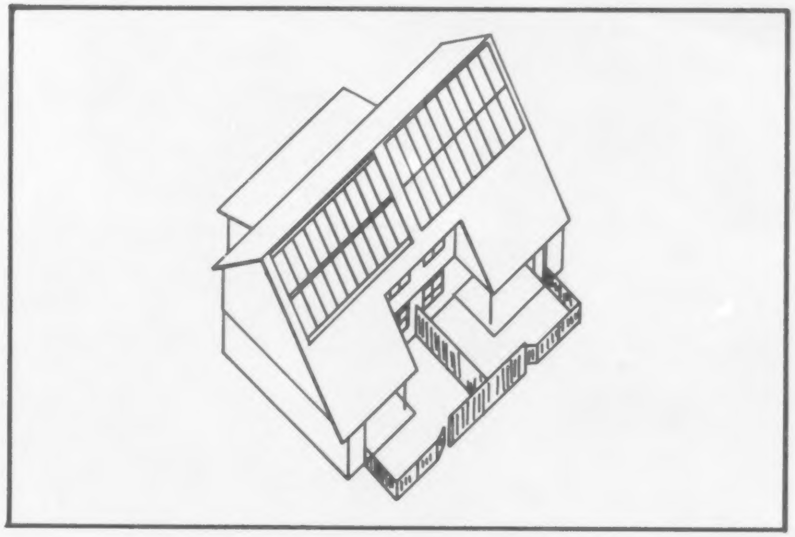
Type: Water

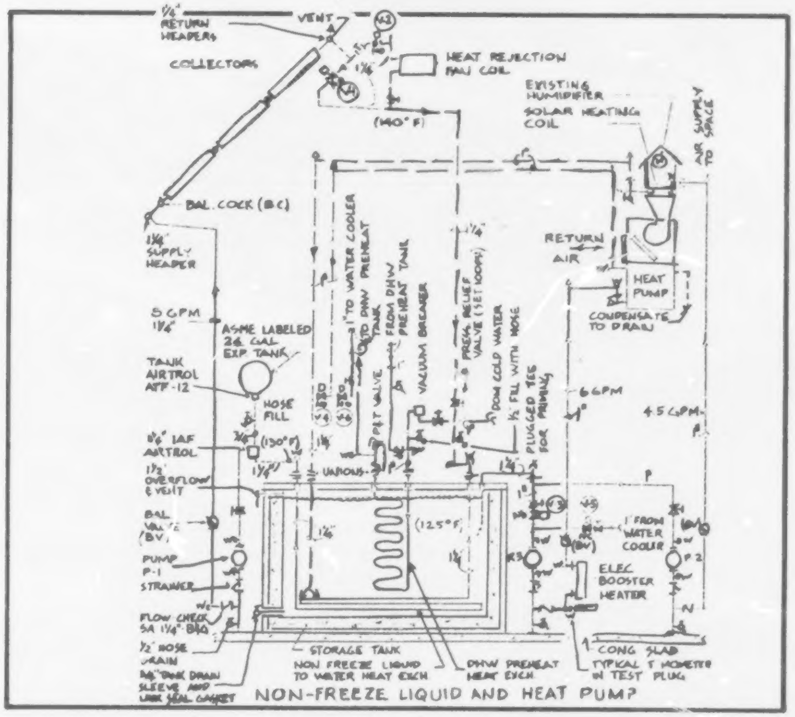
Capacity: 147 cu.ft.

Auxiliary System Type: Water-to-air elec. heat pump

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of using heat pumps with solar heating.




1¼" RETURN HEADERS
VENT
COLLECTORS
HEAT REJECTION FAN COIL
(140° F)
EXISTING HUMIDIFIER
SOLAR HEATING COIL
AIR SUPPLY TO SPACE
BAL. COCK (BC)
1¼" SUPPLY HEADER
1" TO WATER COOLER
TO DHW PREHEAT TANK
FROM DHW PREHEAT TANK
VACUUM BREAKER
PRESS. RELIEF VALVE (SET 100#)
DOM COLD WATER
½" FILL WITH HOSE
PLUGGED TEE FOR PRIMING
RETURN AIR
HEAT PUMP
CONDENSATE TO DRAIN
5 GPM 1¼"
ASME LABELED 24 GAL EXP TANK
TANK AIRTROL ATF-12
HOSE FILL
PET VALVE
6 GPM
4.5 GPM
1¼" IAF AIRTROL
(130°F)
UNIONS
1½" OVERFLOW & VENT
BAL VALVE (BV)
(125°F)
1" FROM WATER COOLER
PUMP P-1
STRAINER
ELEC BOOSTER HEATER
P 2
FLOW CHECK SA 1¼" B&G
½" HOSE DRAIN
STORAGE TANK
NON FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH
CONC SLAB
TYPICAL THERMOMETER IN TEST PLUG
TANK DRAIN SLEEVE AND LINK SEAL GASKET
NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,503 sq.ft.

Location: Fort Campbell, Kentucky

Latitude: 36°N

Climatic Data

Degree Days	Heating	4279	Cooling	2000
Avg. Temp. (°F)	Winter	47	Summer	73
Avg. Insol.(Ly/d)	Winter	260	Summer	472

SOLAR ENERGY SYSTEM

Application Heating 78% Cooling 0% Hot Water 80%

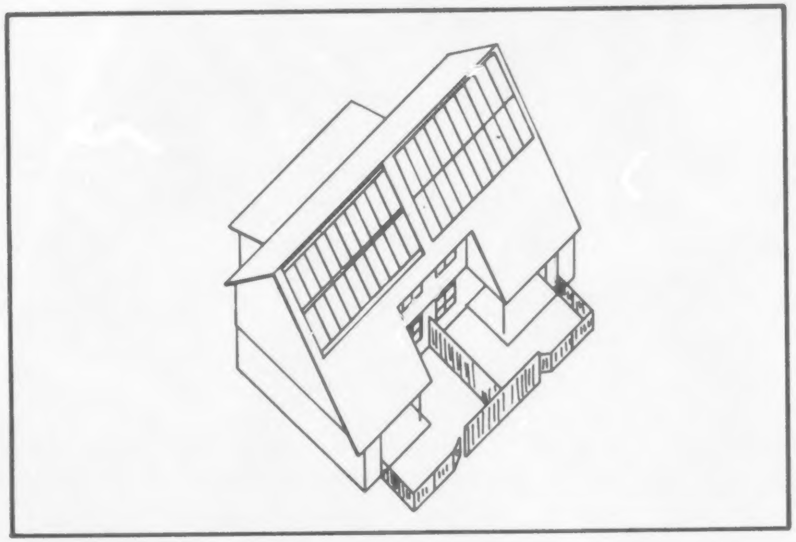
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 420
  Manufacturer: Chamberlain Mfg. Co.

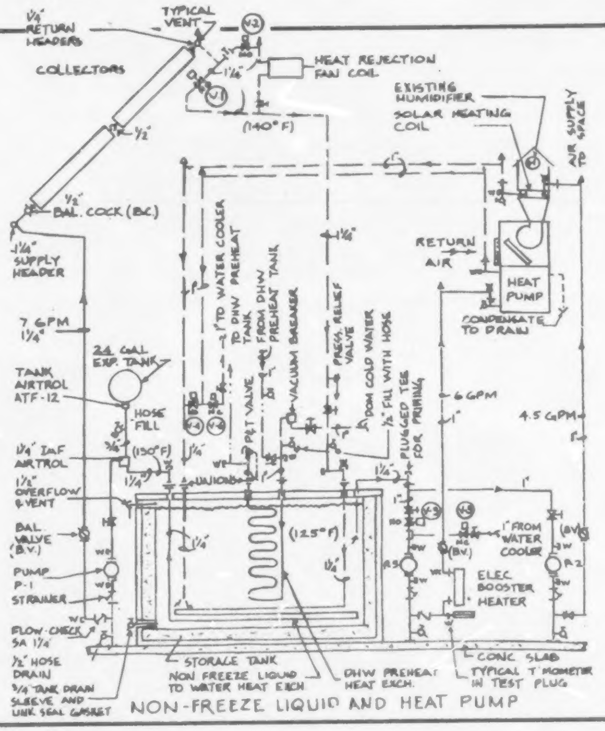
Storage
  Type: Water
  Capacity: 147 cu.ft.

Auxiliary System Type: Water-to-air elec. heat pump

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of using heat pumps with solar heating.




1¼" RETURN HEADERS
TYPICAL VENT
V-2
COLLECTORS
1¼"
V-1
HEAT REJECTION FAN COIL
(140° F)
½"
EXISTING HUMIDIFIER
SOLAR HEATING COIL
AIR SUPPLY TO SPACE
½" BAL. COCK (BC)
1¼" SUPPLY HEADER
RETURN AIR
HEAT PUMP
CONDENSATE TO DRAIN
1¼"
1" TO WATER COOLER
TO DHW PREHEAT TANK
FROM DHW PREHEAT TANK
VACUUM BREAKER
PRESS. RELIEF VALVE
DOM COLD WATER
½" FILL WITH HOSE
PLUGGED TEE FOR PRIMING
PET VALVE
7 GPM 1¼"
24 GAL EXP. TANK
TANK AIRTROL ATF-12
HOSE FILL
6 GPM
4.5 GPM
1"
1¼" I&F AIRTROL
(150°F)
1¼"
UNION
1½" OVERFLOW & VENT
BAL. VALVE (B.V.)
PUMP P-1
STRAINER
FLOW-CHECK SA 1¼"
½" HOSE DRAIN
¾ TANK DRAIN SLEEVE AND LINK SEAL GASKET
(125°F)
V-3
V-5
1" FROM WATER COOLER
(B.V.)
(BV)
P-3
P-2
ELEC BOOSTER HEATER
STORAGE TANK
NON FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH.
CONC SLAB
TYPICAL T'MOMETER IN TEST PLUG

NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,503 sq.ft.

Location: Fort Campbell, Kentucky

Latitude: 36°N

Climatic Data

Degree Days	Heating 4279	Cooling 2000
Avg. Temp. (°F)	Winter 47	Summer 73
Avg. Insol.(Ly/d)	Winter 260	Summer 472

SOLAR ENERGY SYSTEM

Application Heating 63% Cooling 0% Hot Water 75%

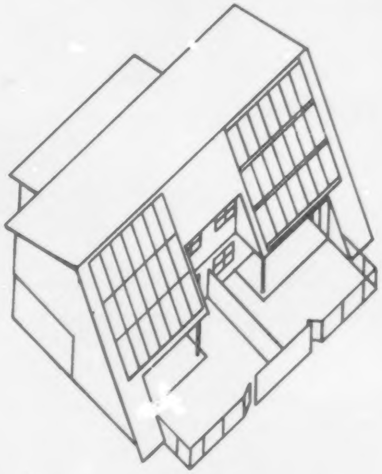
Collector
  Type: Air flat-plate
  Area (sq. ft.): 410
  Manufacturer: Solaron Corp.

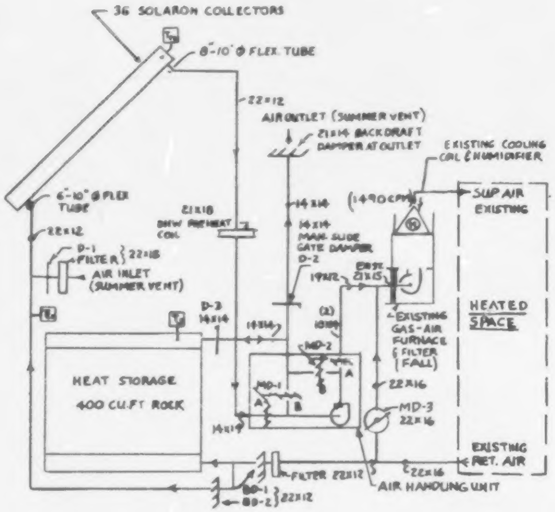
Storage
  Type: Rock
  Capacity: 224 cu.ft.

Auxiliary System Type: Water-to-air electric heat pump

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of using heat pumps with solar heating.




36 SOLARON COLLECTORS
8"-10" Ø FLEX. TUBE
22×12
AIR OUTLET (SUMMER VENT)
21×14 BACKDRAFT DAMPER AT OUTLET
EXISTING COOLING COIL & HUMIDIFIER
6"-10" Ø FLEX TUBE
21×18 DHW PREHEAT COIL
14×14
(1490 CFM)
SUP. AIR EXISTING
14×14 MAN. SLIDE GATE DAMPER D-2
22×12
D-1 FILTER } 22×18
AIR INLET (SUMMER VENT)
19×12
EXIST. 21×15
D-3 14×14
14×14
(2) 10×10
MD-2
EXISTING GAS-AIR FURNACE & FILTER (FALL)
HEATED SPACE
HEAT STORAGE 400 CU.FT ROCK
MD-1
A
B
A
22×16
MD-3 22×16
14×19
EXISTING RET. AIR
FILTER 22×12
22×16
AIR HANDLING UNIT
BD-1
BD-2 } 22×12

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,503 sq.ft.

Location: Fort Campbell, Kentucky

Latitude: 36°N

Climatic Data

Degree Days	Heating	4279	Cooling	2000
Avg. Temp. (°F)	Winter	47	Summer	73
Avg. Insol.(Ly/d)	Winter	260	Summer	472

SOLAR ENERGY SYSTEM

Application Heating 58% Cooling 0% Hot Water 70%

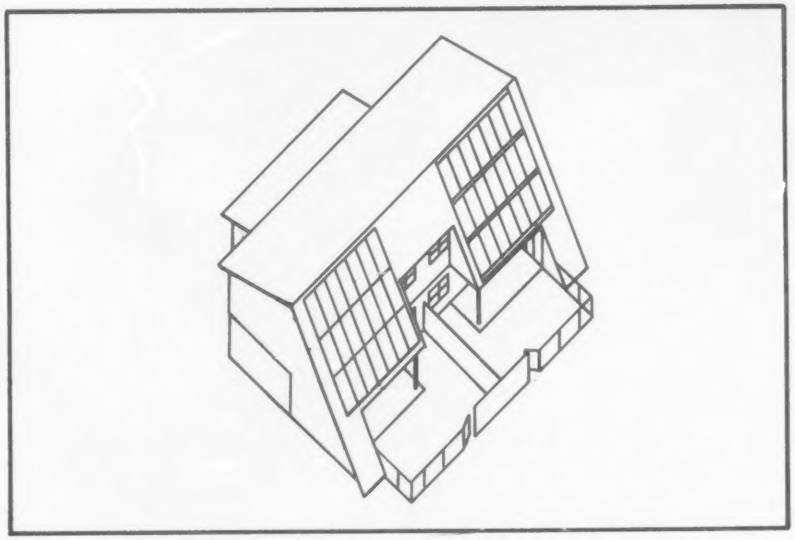
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 84
  Manufacturer: Sunworks, Inc.

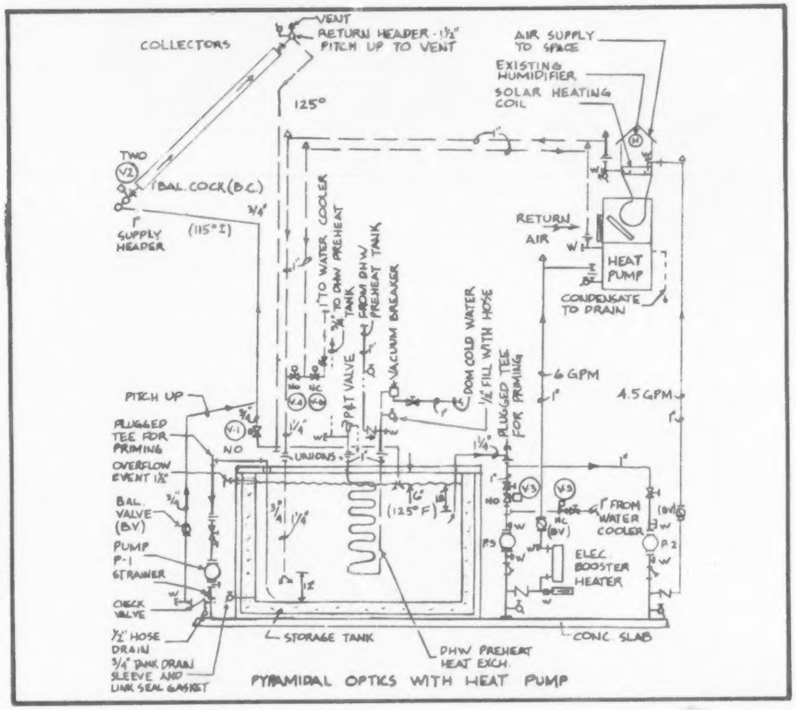
Storage
  Type: Rock
  Capacity: 147 cu.ft.

Auxiliary System Type: Air-to-air elec. heat pump

PROJECT DESCRIPTION

Objective(s): To compare alternative methods of using heat pumps with solar heating.




VENT
RETURN HEADER - 1½" PITCH UP TO VENT
COLLECTORS
AIR SUPPLY TO SPACE
EXISTING HUMIDIFIER
SOLAR HEATING COIL
125°
TWO
V2
BAL. COCK (B.C.)
3/4"
1"
SUPPLY HEADER
(115° I)
RETURN AIR
W
HEAT PUMP
CONDENSATE TO DRAIN
1" TO WATER COOLER
¾" TO DHW PREHEAT TANK
FROM DHW PREHEAT TANK
VACUUM BREAKER
DOM COLD WATER
½" FILL WITH HOSE
PLUGGED TEE FOR PRIMING
6 GPM
4.5 GPM
PITCH UP
PLUGGED TEE FOR PRIMING
V-1
NO
V-4
V-6
NC
P&T VALVE
1¼"
UNIONS
OVERFLOW EVENT 1½"
BAL. VALVE (B.V)
PUMP P-1
STRAINER
CHECK VALVE
½" HOSE DRAIN
3/4" TANK DRAIN SLEEVE AND LINK SEAL GASKET
6"
(125°F)
1'2"
V3
V5
1" FROM WATER COOLER
(BV)
P3
P2
ELEC. BOOSTER HEATER
STORAGE TANK
DHW PREHEAT HEAT EXCH.
CONC. SLAB

PYRAMIDAL OPTICS WITH HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,438 sq.ft.

Location: New Orleans Naval Complex, Louisiana

Latitude: 30°N

Climatic Data

Degree Days	Heating 1317	Cooling 3400
Avg. Temp. (°F)	Winter 55	Summer 76
Avg. Insol.(Ly/d)	Winter 311	Summer 480

SOLAR ENERGY SYSTEM

Application Heating 82% Cooling 0% Hot Water 90%

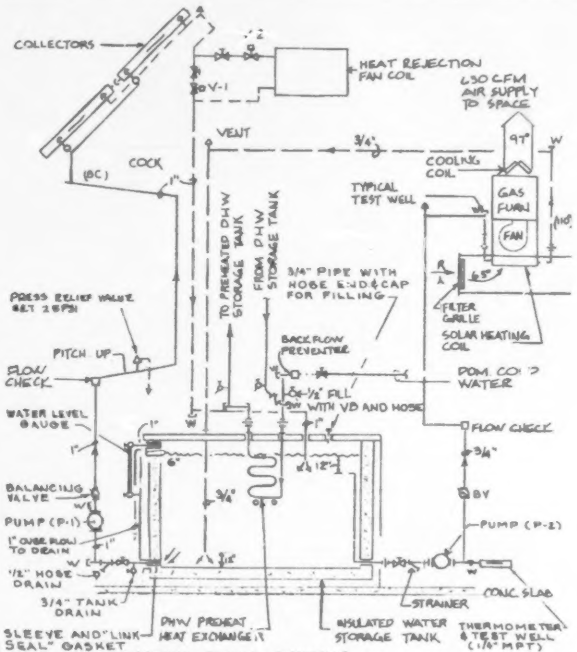
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 252
  Manufacturer: Sunworks, Inc.

Storage
  Type: Water
  Capacity: 53 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the effectiveness of high performance collectors at non-optimum tilts.


COLLECTORS
V-1
V-2
HEAT REJECTION FAN COIL
630 CFM AIR SUPPLY TO SPACE
VENT
3/4"
97°
W
(BC)
COCK
1"
COOLING COIL
TYPICAL TEST WELL
GAS FURN
FAN
110°
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
3/4" PIPE WITH HOSE END & CAP FOR FILLING
R
A
65°
FILTER GRILLE
SOLAR HEATING COIL
PRESS RELIEF VALVE SET 25PSI
PITCH UP
FLOW CHECK
BACKFLOW PREVENTER
DOM. COLD WATER
1/2" FILL WITH VB AND HOSE
WATER LEVEL GAUGE
FLOW CHECK
1"
6"
12"
3/4"
BALANCING VALVE
BV
PUMP (P-1)
PUMP (P-2)
1" OVERFLOW TO DRAIN
1/2" HOSE DRAIN
3/4" TANK DRAIN
CONC. SLAB
STRAINER
SLEEVE AND "LINK-SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK
THERMOMETER & TEST WELL (1/4" MPT)

NON-DRAIN DOWN SYSTEMS

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,438 sq.ft.

Location: New Orleans Naval Complex, Louisiana

Latitude: 30°N

Climatic Data

Degree Days	Heating 1317	Cooling 3400
Avg. Temp. (°F)	Winter 55	Summer 76
Avg. Insol.(Ly/d)	Winter 311	Summer 480

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 90%

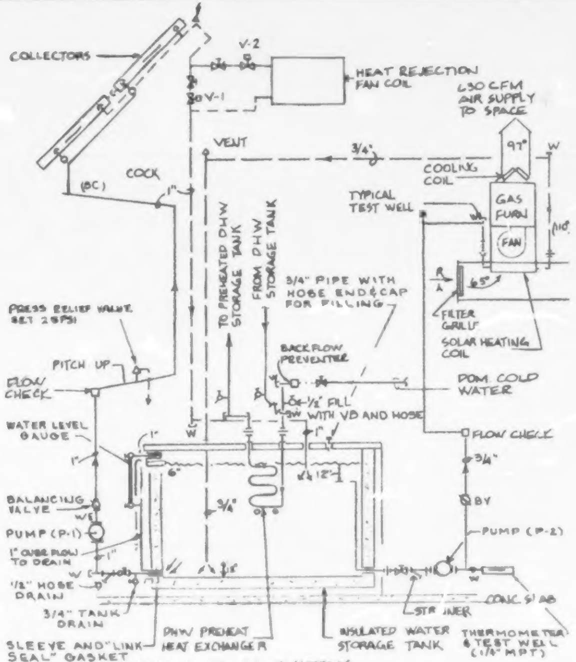
Collector
  Type: Evacuated tube
  Area (sq. ft.): 288
  Manufacturer: Owens Illinois Company

Storage
  Type: Water
  Capacity: 53 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the effectiveness of high performance collectors at non-optimum tilts.


COLLECTORS
V-2
V-1
HEAT REJECTION FAN COIL
630 CFM AIR SUPPLY TO SPACE
97°
W
VENT
3/4"
COOLING COIL
(BC)
COCK
1"
TYPICAL TEST WELL
GAS FURN
FAN
110°
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
3/4" PIPE WITH HOSE END & CAP FOR FILLING
R A
65°
FILTER GRILL
SOLAR HEATING COIL
PRESS RELIEF VALVE SET 25PSI
BACKFLOW PREVENTER
PITCH UP
FLOW CHECK
DOM COLD WATER
1/2" FILL WITH VB AND HOSE
WATER LEVEL GAUGE
FLOW CHECK
6"
12"
BALANCING VALVE
BY
PUMP (P-1)
PUMP (P-2)
1" OVER FLOW TO DRAIN
1/2" HOSE DRAIN
CONC SLAB
3/4" TANK DRAIN
STRAINER
SLEEVE AND "LINK-SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK
THERMOMETER & TEST WELL (1/4" MPT)

NON-DRAIN DOWN SYSTEMS

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,484 sq.ft.

Location: New Orleans Naval Complex, Louisiana

Latitude: 30°N

Climatic Data

Degree Days	Heating	1317	Cooling	3400
Avg. Temp. (°F)	Winter	55	Summer	76
Avg. Insol.(Ly/d)	Winter	311	Summer	480

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 90%

Collector
  Type: Liquid, heat trap flat-plate
  Area (sq. ft.): 270
  Manufacturer: Daystar

Storage
  Type: Water
  Capacity: 53 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the effectiveness of high performance collectors at non-optimum tilts.

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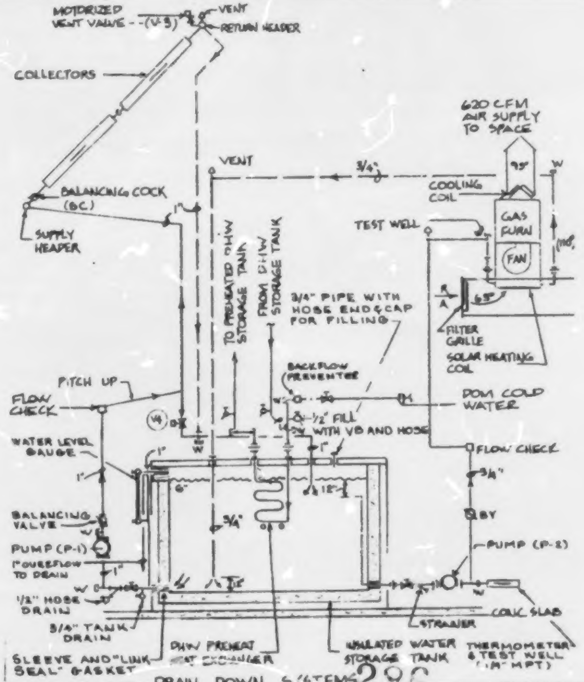

MOTORIZED VENT VALVE -(V-3)
VENT
RETURN HEADER
COLLECTORS
620 CFM AIR SUPPLY TO SPACE
95°
W
VENT
3/4"
COOLING COIL
BALANCING COCK (BC)
1"
SUPPLY HEADER
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
TEST WELL
GAS FURN
FAN
110°
R A
65°
3/4" PIPE WITH HOSE END & CAP FOR FILLING
FILTER GRILLE
SOLAR HEATING COIL
PITCH UP
BACKFLOW PREVENTER
FLOW CHECK
DOM COLD WATER
V4
1/2" FILL WITH VB AND HOSE
W
1"
FLOW CHECK
WATER LEVEL GAUGE
1"
6"
12"
3/4"
1"
3/4"
BY
BALANCING VALVE
W
PUMP (P-1)
PUMP (P-2)
1" OVERFLOW TO DRAIN
1"
W
1/2" HOSE DRAIN
CONC SLAB
3/4" TANK DRAIN
STRAINER
SLEEVE AND "LINK SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK
THERMOMETER & TEST WELL (1/2" MPT)

DRAIN DOWN SYSTEMS

296

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1,484 sq.ft.

Location: New Orleans Naval Complex, Louisiana

Latitude: 30°N

Climatic Data

Degree Days	Heating	1317	Cooling	3400
Avg. Temp. (°F)	Winter	55	Summer	76
Avg. Insol.(Ly/d)	Winter	311	Summer	480

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 85%

Collector
  Type: Liquid, heat trap flat-plate
  Area (sq. ft.): 251
  Manufacturer: Sunsav

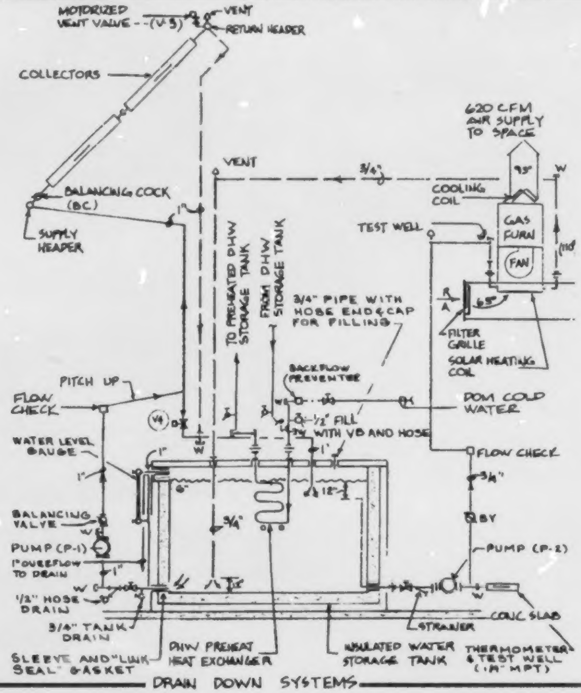
Storage
  Type: Water
  Capacity: 53 cu.ft.

Auxiliary System Type: Gas furnace

PROJECT DESCRIPTION

Objective(s): To demonstrate the effectiveness of high performance collectors at non-optimum tilts.

297


MOTORIZED VENT VALVE (V-3)
VENT
RETURN HEADER
COLLECTORS
620 CFM AIR SUPPLY TO SPACE
VENT
3/4"
95°
W
COOLING COIL
BALANCING COCK (BC)
1"
SUPPLY HEADER
TEST WELL
GAS FURN
FAN
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
110°
3/4" PIPE WITH HOSE END & CAP FOR FILLING
R
A
65°
FILTER GRILLE
SOLAR HEATING COIL
PITCH UP
BACKFLOW PREVENTER
FLOW CHECK
DOM COLD WATER
V4
1/2" FILL WITH VB AND HOSE
W
WATER LEVEL GAUGE
1"
FLOW CHECK
3/4"
1"
6"
12"
BALANCING VALVE
3/4"
BY
PUMP (P-1)
PUMP (P-2)
1" OVERFLOW TO DRAIN
1"
W
W
1/2" HOSE DRAIN
CONC SLAB
3/4" TANK DRAIN
STRAINER
SLEEVE AND "LINK SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK
THERMOMETER & TEST WELL (1/2" MPT)
DRAIN DOWN SYSTEMS

298

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

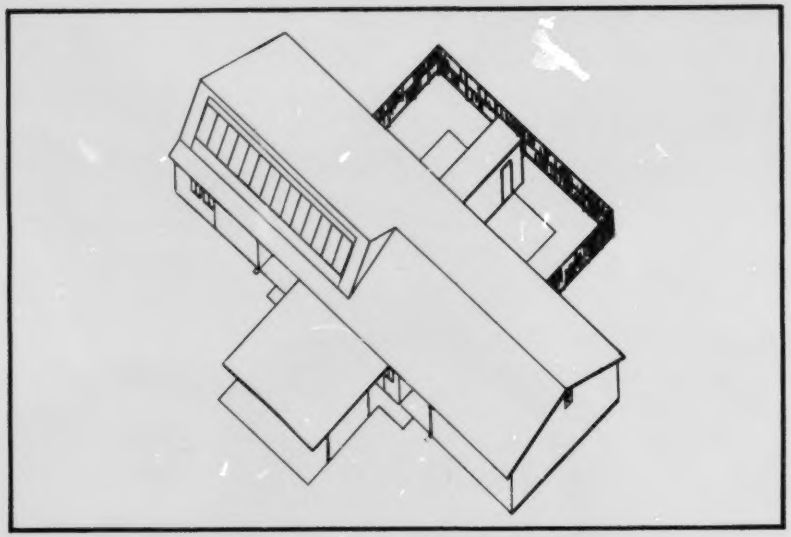
Building
  Type: Residential, single family 2 units
  Area: 1,658 sq.ft.

Location: Fort Polk, Louisiana

Latitude: 31°N

Climatic Data

Degree Days	Heating	1575	Cooling	3100
Avg. Temp. (°F)	Winter	54	Summer	75
Avg. Insol.(Ly/d)	Winter	311	Summer	480



SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 0% Hot Water 95%

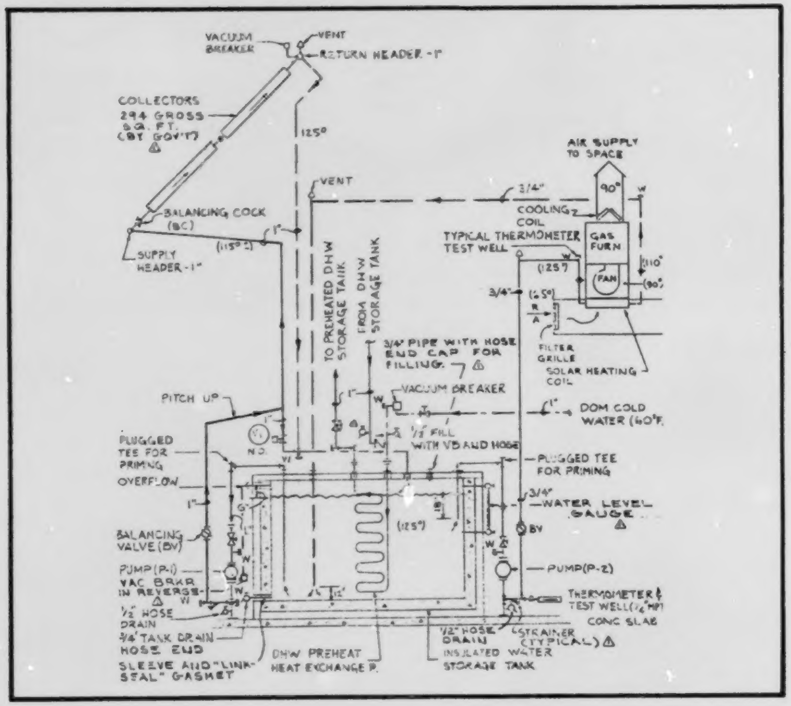
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 256
  Manufacturer: Sunworks, Inc.

Storage
  Type: Water
  Capacity: 75 cu.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare solar heating of garden apartments, single family houses and rowhouses.


VACUUM BREAKER
VENT
RETURN HEADER - 1"
COLLECTORS 294 GROSS SQ. FT. (BY GOV'T)
125°
VENT
3/4"
AIR SUPPLY TO SPACE
90°
W
COOLING COIL
GAS FURN
FAN
TYPICAL THERMOMETER TEST WELL
(125°)
110°
(90°)
3/4"
(45°)
R
A
FILTER GRILLE
SOLAR HEATING COIL
BALANCING COCK (BC)
1"
(115° ±)
SUPPLY HEADER - 1"
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
3/4" PIPE WITH HOSE END CAP FOR FILLING
VACUUM BREAKER
1"
DOM COLD WATER (40°F)
PITCH UP
1/2" FILL WITH VB AND HOSE
PLUGGED TEE FOR PRIMING
N.O.
OVERFLOW
PLUGGED TEE FOR PRIMING
3/4"
WATER LEVEL GAUGE
1"
(125°)
BV
BALANCING VALVE (BV)
PUMP (P-1)
VAC BRKR IN REVERSE
PUMP (P-2)
THERMOMETER & TEST WELL (1/4" MPT)
1/2" HOSE DRAIN
CONC SLAB
3/4" TANK DRAIN HOSE END
1/2" HOSE DRAIN
STRAINER (TYPICAL)
SLEEVE AND "LINK-SEAL" GASKET
DHW PREHEAT HEAT EXCHANGER
INSULATED WATER STORAGE TANK

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse 2 units

Area: 1,500 sq.ft.

Location: Fort Polk, Louisiana

Latitude: 31°N

Climatic Data

Degree Days	Heating	1575	Cooling	3100
Avg. Temp. (°F)	Winter	54	Summer	75
Avg. Insol.(Ly/d)	Winter	311	Summer	480

SOLAR ENERGY SYSTEM

Application Heating 90% Cooling 0% Hot Water 95%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 294

Manufacturer: Sunworks, Inc.

Storage

Type: Water

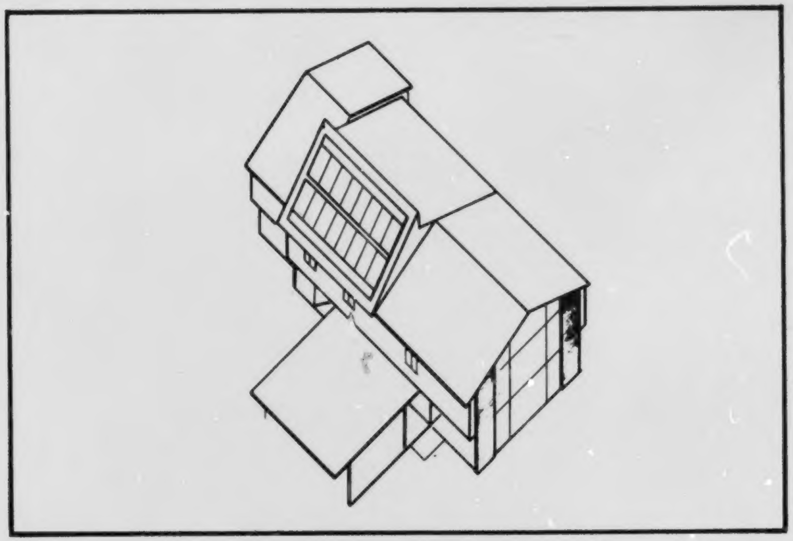
Capacity: 75 cu.ft.

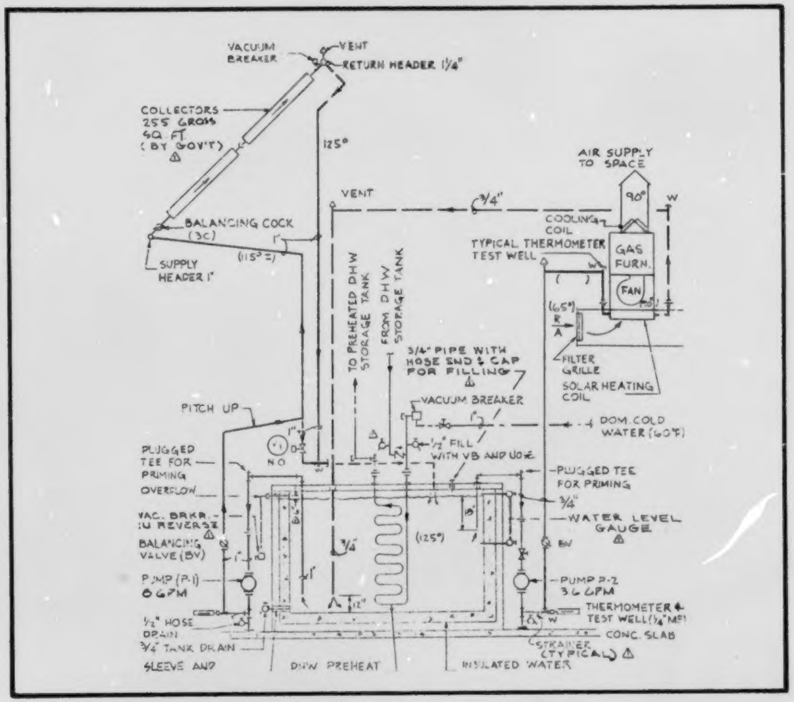
Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare solar heating of garden apartments, single family houses and rowhouses.

291




VACUUM BREAKER
VENT
RETURN HEADER 1¼"
COLLECTORS 255 GROSS SQ. FT. (BY GOV'T) △
125°
VENT
¾"
AIR SUPPLY TO SPACE
90°
W
COOLING COIL
TYPICAL THERMOMETER TEST WELL
GAS FURN.
FAN
BALANCING COCK (3C)
1"
(115°±)
SUPPLY HEADER 1"
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
(65°)
R A
FILTER GRILLE
SOLAR HEATING COIL
3/4" PIPE WITH HOSE END & CAP FOR FILLING △
VACUUM BREAKER
PITCH UP
1"
NO
½" FILL WITH VB AND UOE
DOM. COLD WATER (60°F)
PLUGGED TEE FOR PRIMING
OVERFLOW
PLUGGED TEE FOR PRIMING
¾"
VAC. BRKR. IU REVERSE △
WATER LEVEL GAUGE △
BALANCING VALVE (BV)
¾"
(125°)
BV
PUMP (P-1) 6 GPM
1"
12"
PUMP P-2 36 GPM
THERMOMETER & TEST WELL (¼" MP)
½" HOSE DRAIN
¾" TANK DRAIN
CONC. SLAB
STRAINER (TYPICAL) △
SLEEVE AND
DHW PREHEAT
INSULATED WATER

292

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
- Type: Residential, apartment 2 units
- Area: 1,126 sq.ft.

Location: Fort Polk, Louisiana

Latitude: 31°N

Climatic Data

Degree Days	Heating	1575	Cooling	3100
Avg. Temp. (°F)	Winter	54	Summer	75
Avg. Insol.(Ly/d)	Winter	311	Summer	480

SOLAR ENERGY SYSTEM

Application Heating 91% Cooling 0% Hot Water 92%

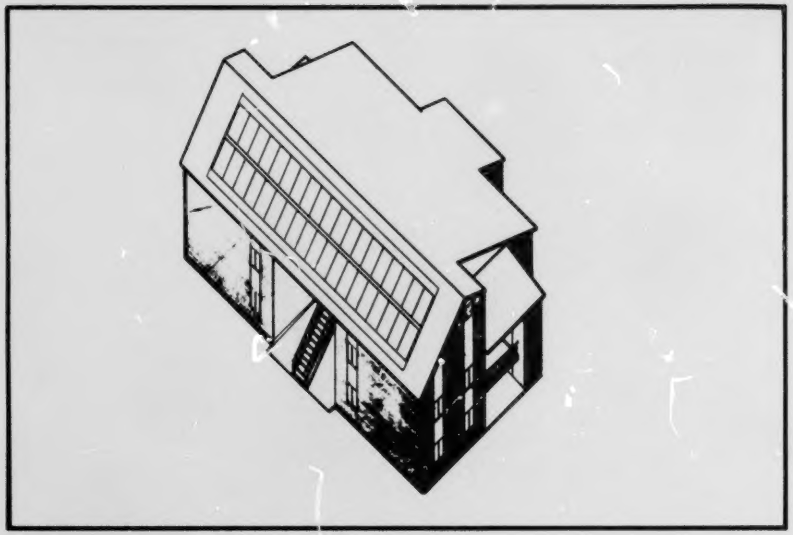
Collector
- Type: Liquid flat-plate
- Area (sq. ft.): 798
- Manufacturer: Sunworks, Inc.

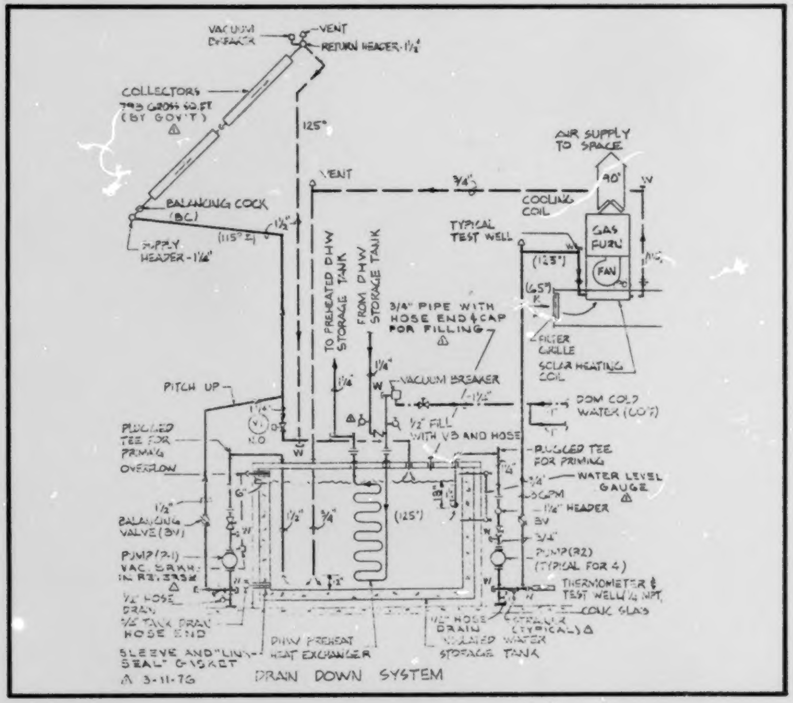
Storage
- Type: Water
- Capacity: 160 cu.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare solar heating of garden apartments, single family houses and rowhouses.




VACUUM BREAKER
VENT
RETURN HEADER-1½"
COLLECTORS
793 GROSS SQ.FT
(BY GOV'T)
125°
VENT
3/4"
BALANCING COCK
(BC)
1½"
(115° ±)
SUPPLY
HEADER-1¼"
TO PREHEATED DHW STORAGE TANK
FROM DHW STORAGE TANK
AIR SUPPLY
TO SPACE
90°
COOLING
COIL
TYPICAL
TEST WELL
GAS
FURN
FAN
(125°)
(65°)
3/4" PIPE WITH
HOSE END & CAP
FOR FILLING
FILTER
GRILLE
SOLAR HEATING
COIL
1¼"
VACUUM BREAKER
-1¼"
DOM COLD
WATER (CW)
½" FILL
WITH VB AND HOSE
PITCH UP
PLUGGED
TEE FOR
PRIMING
OVERFLOW
N.O
W
PLUGGED TEE
FOR PRIMING
3/4" WATER LEVEL
GAUGE
1½"
BALANCING
VALVE (BV)
6"
1½"
3/4"
(125°)
5GPM
1½" HEADER
BV
3/4"
PUMP(P1)
VAC. BRKR.
IN REVERSE
PUMP(P2)
(TYPICAL FOR 4)
THERMOMETER &
TEST WELL ¼ NPT
½" HOSE
DRAIN
½" TANK DRAIN
HOSE END
COCK GLASS
½" HOSE
DRAIN
STRAINER
(TYPICAL)
INSULATED WATER
STORAGE TANK
DHW PREHEAT
HEAT EXCHANGER
SLEEVE AND "LINK-
SEAL" GASKET
3-11-76
DRAIN DOWN SYSTEM

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, single family
  Area: 1487 sq.ft.

Location: Andrews Air Force Base, Maryland

Latitude: 38°N

Climatic Data

Degree Days	Heating 4333	Cooling 600
Avg. Temp. (°F)	Winter 46	Summer 67
Avg. Insol.(Ly/d)	Winter 260	Summer 453

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 85%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 672
  Manufacturer: Sunworks, Inc.

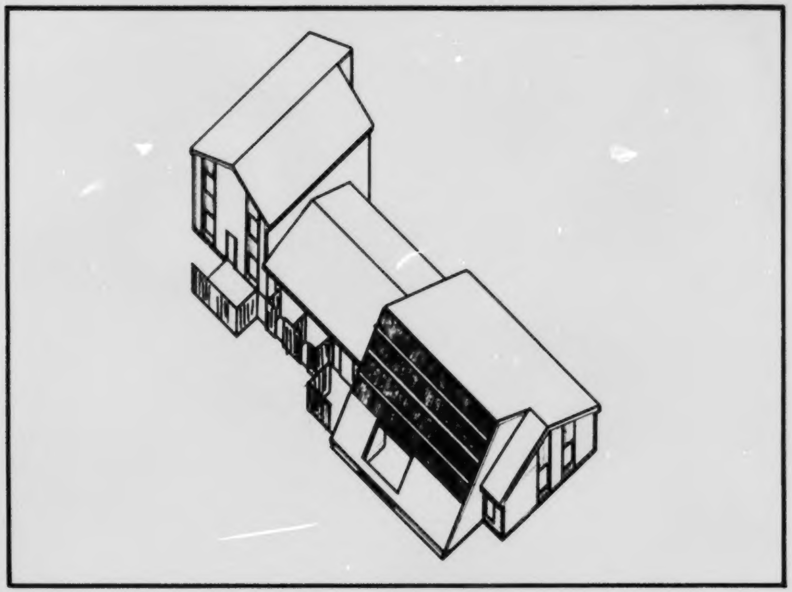
Storage
  Type: Water
  Capacity: 133 sq.ft.

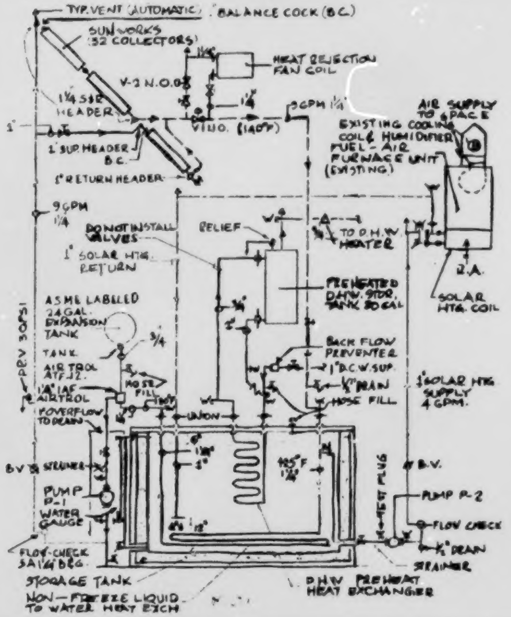
Auxiliary System Type: Oil furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air and higher performance collectors in a temperate climate.

295




TYP. VENT (AUTOMATIC)
BALANCE COCK (B.C.)
SUNWORKS (32 COLLECTORS)
HEAT REJECTION FAN COIL
V-2 N.O.
1¼ S&R HEADER
1¼
9GPM 1¼
V-1 N.O. (140°F)
1"
1" SUP. HEADER
B.C.
1" RETURN HEADER
AIR SUPPLY TO SPACE
EXISTING COOLING COIL & HUMIDIFIER
FUEL-AIR FURNACE UNIT (EXISTING)
9GPM 1¼
DO NOT INSTALL VALVES
RELIEF
TO D.H.W. HEATER
1" SOLAR HTG. RETURN
PREHEATED D.H.W. STOR. TANK 80 GAL
R.A.
SOLAR HTG. COIL
ASME LABELLED 24 GAL. EXPANSION TANK
3/4
PRV 30PSI
TANK
AIR TROL ATF-12.
BACK FLOW PREVENTER
1" D.C.W. SUP.
½" DRAIN
HOSE FILL
1" SOLAR HTG SUPPLY 4 GPM.
1¼" IAF AIRTROL
OVERFLOW TO DRAIN
UNION
B.V.
STRAINER
PUMP P-1
WATER GAUGE
TEST PLUG
PUMP P-2
FLOW CHECK
½" DRAIN
FLOW-CHECK SA 1¼ BRG.
STRAINER
STORAGE TANK
NON-FREEZE LIQUID TO WATER HEAT EXCH
D.H.W. PREHEAT HEAT EXCHANGER

296

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, single family 2 units

Area: 1487 sq.ft.

Location: Andrews Air Force Base, Maryland

Latitude: 38°N

Climatic Data

Degree Days	Heating	4333	Cooling	1237
Avg. Temp. (°F)	Winter	46	Summer	67
Avg. Insol.(Ly/d)	Winter	260	Summer	453

SOLAR ENERGY SYSTEM

Application Heating 73% Cooling 0% Hot Water 80%

Collector

Type: Air flat-plate

Area (sq. ft.): 624

Manufacturer: Solaron Corp.

Storage

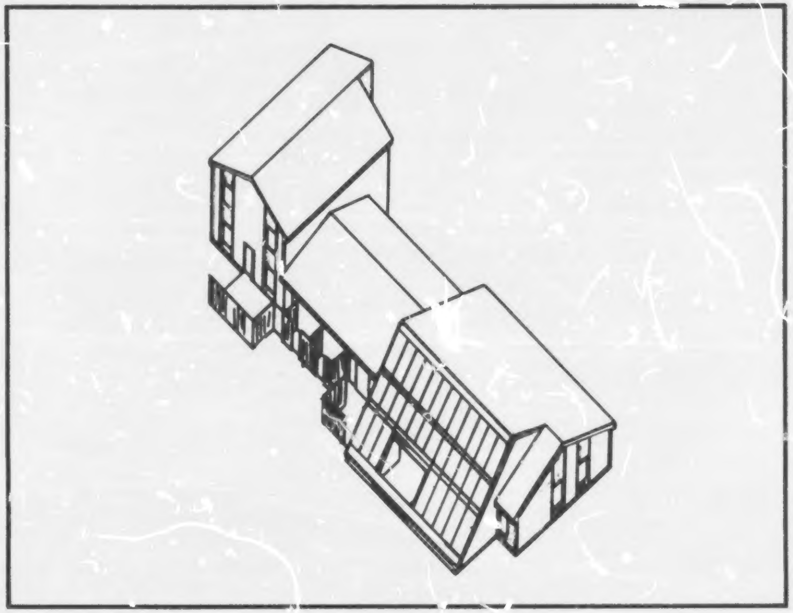
Type: Rock

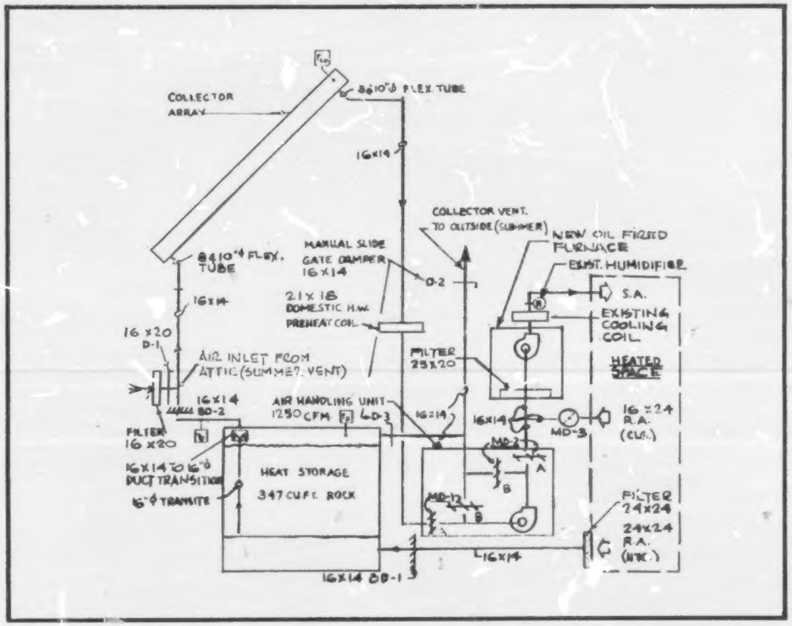
Capacity: 347 sq.ft.

Auxiliary System Type: Oil furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air and higher performance collectors in a temperate climate.




COLLECTOR ARRAY
8ø10"ø FLEX TUBE
16×14
8ø10"ø FLEX. TUBE
16×14
16×20 D-1
AIR INLET FROM ATTIC (SUMMER VENT)
16×14 BD-2
FILTER 16×20
16×14 TO 16"ø DUCT TRANSITION
16"ø TRANSITE
HEAT STORAGE 347 CU.FT. ROCK
MANUAL SLIDE GATE DAMPER 16×14
21×18 DOMESTIC H.W. PREHEAT COIL
D-2
COLLECTOR VENT. TO OUTSIDE (SUMMER)
NEW OIL FIRED FURNACE
EXIST. HUMIDIFIER
S.A.
EXISTING COOLING COIL
HEATED SPACE
FILTER 25×20
AIR HANDLING UNIT 1250 CFM
BD-3
16×14
16×14
MD-3
16×24 R.A. (CLG.)
MD-2
A
B
MD-1
B
FILTER 24×24
24×24 R.A. (HTG.)
16×14
16×14 BD-1

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, single family

Area: 1487 sq.ft.

Location: Andrews Air Force Base, Maryland

Latitude: 38°N

Climatic Data

Degree Days	Heating	4333	Cooling	1237
Avg. Temp. (°F)	Winter	46	Summer	67
Avg. Insol.(Ly/d)	Winter	260	Summer	453

SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 80%

Collector

Type: Evacuated tube

Area (sq. ft.): 576

Manufacturer: Owens Illinois Company

Storage

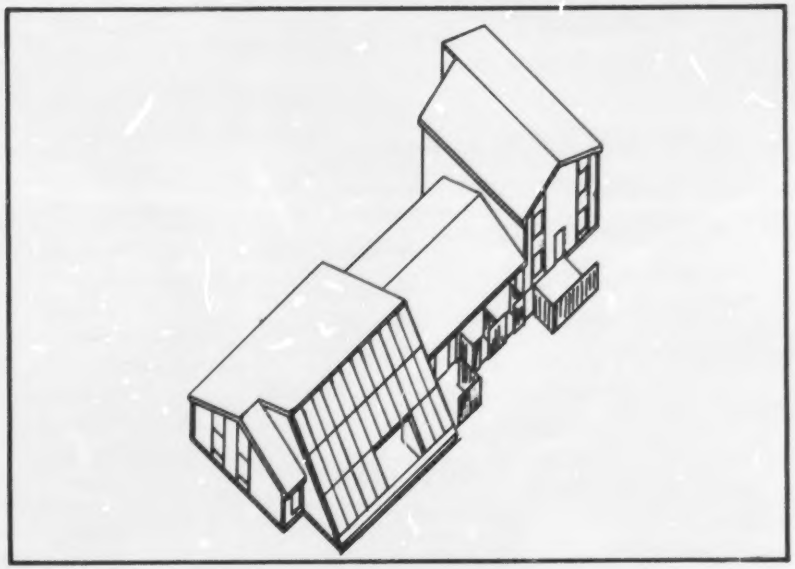
Type: Water

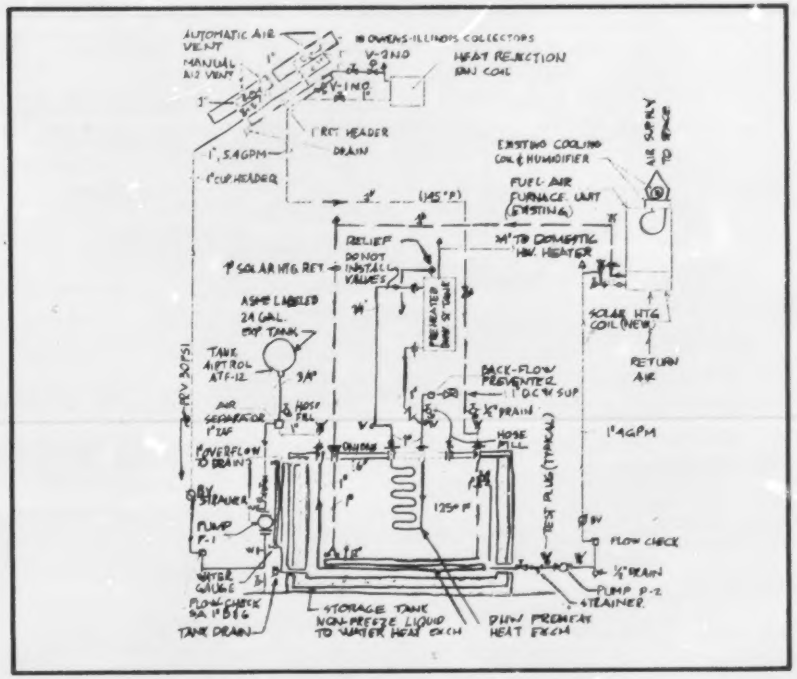
Capacity: 133 sq.ft.

Auxiliary System Type: Oil furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air and higher performance collectors in a temperate climate.




AUTOMATIC AIR VENT
MANUAL AIR VENT
OWENS-ILLINOIS COLLECTORS
V-2NO
HEAT REJECTION FAN COIL
V-1NO
1"
1" RET HEADER DRAIN
1", 5.4GPM
1" CUP HEADER
(145°F)
EXISTING COOLING COIL & HUMIDIFIER
AIR SUPPLY
FUEL-AIR FURNACE UNIT (EXISTING)
RELIEF
DO NOT INSTALL VALVES
3/4" TO DOMESTIC HW. HEATER
1" SOLAR HTG RET
ASME LABELED 24 GAL. EXP TANK
PREHEATED
SOLAR HTG COIL (NEW)
RETURN AIR
TANK AIPTROL ATF-12
3/4"
PRV 30PSI
BACK-FLOW PREVENTER
1" DCW SUP
3/4" DRAIN
AIR SEPARATOR 1" IAF
HOSE FILL
OVERFLOW TO DRAIN
1"4GPM
STRAINER
125°F
TEST PLUG (TYPICAL)
PUMP P-1
FLOW CHECK
1/2" DRAIN
WATER GAUGE
PUMP P-2
STRAINER
FLOW CHECK
TANK DRAIN
STORAGE TANK
NON-FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH

299

300

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

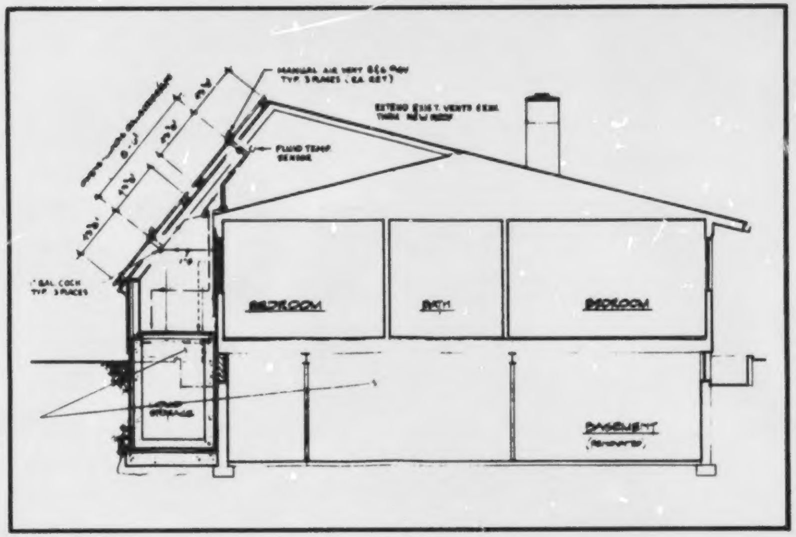
Building
  Type: Residential, single family
  Area: 1996 sq.ft.(total); 1597(conditioned)

Location: Offutt Air Force Base, Nebraska

Latitude: 41°N

Climatic Data

Degree Days	Heating	6160	Cooling	1500
Avg. Temp. (°F)	Winter	39	Summer	67
Avg. Insol.(Ly/d)	Winter	273	Summer	482


BEDROOM
BATH
BEDROOM
BASEMENT
STORAGE

SOLAR ENERGY SYSTEM

Application Heating 50% Cooling 0% Hot Water 65%

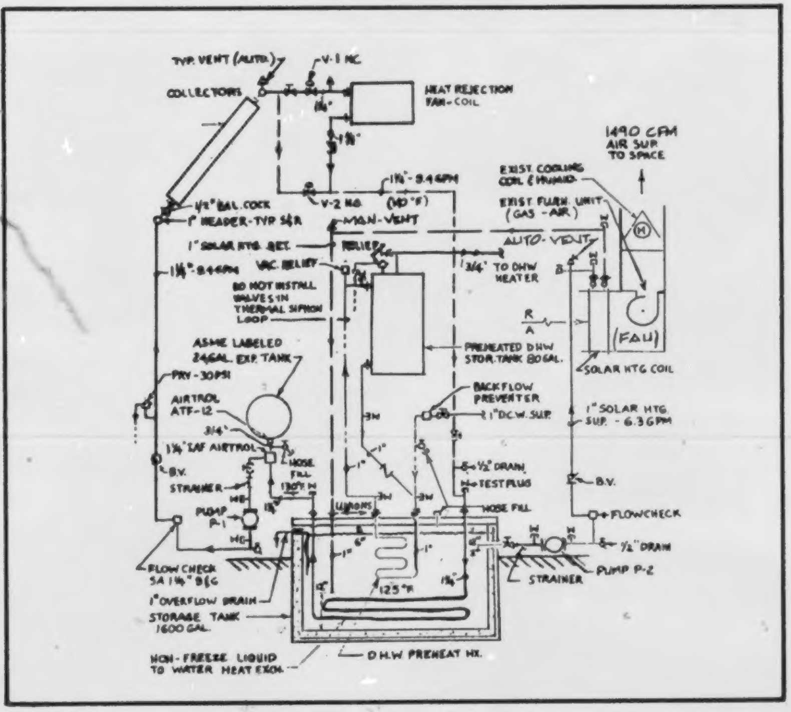
Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 468
  Manufacturer: Honeywell, Inc.

Storage
  Type: Water
  Capacity: 217 sq.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air, and higher performance collectors in a cold climate.


TYP. VENT (AUTO.)
V-1 NC
COLLECTORS
1¼"
HEAT REJECTION FAN-COIL
1¼"
1490 CFM AIR SUP. TO SPACE
EXIST. COOLING COIL & HUMID.
1¼" - 9.4 GPM
(110°F)
V-2 NO
EXIST. FURN. UNIT (GAS - AIR)
1/2" BAL. COCK
1" HEADER-TYP. S&R
MAN-VENT
AUTO-VENT
1" SOLAR HTG. RET.
RELIEF
1¼" - 9.4 GPM
VAC. RELIEF
3/4" TO DHW HEATER
DO NOT INSTALL VALVES IN THERMAL SIPHON LOOP
R
A
(FAU)
ASME LABELED 24 GAL. EXP. TANK
PREHEATED DHW STOR. TANK 80 GAL.
SOLAR HTG COIL
PRV - 30 PSI
AIRTROL ATF-12
BACKFLOW PREVENTER
1" DCW. SUP.
1" SOLAR HTG. SUP. - 6.3 GPM
3/4"
1¼" IAF AIRTROL
HOSE FILL
B.V.
1/2" DRAIN
STRAINER
130°F
TEST PLUG
B.V.
UNIONS
3W
3W
3W
HOSE FILL
PUMP P-1
FLOWCHECK
1/2" DRAIN
FLOW CHECK SA 1¼" B&G
PUMP P-2
STRAINER
125°F
1" OVERFLOW DRAIN
STORAGE TANK 1600 GAL.
NON-FREEZE LIQUID TO WATER HEAT EXCH.
D.H.W. PREHEAT HX.

301

302

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, single family
  Area: 1996 sq.ft.(total); 1597(conditioned)

Location: Offutt Air Force Base, Nebraska

Latitude: 41°N

Climatic Data

Degree Days	Heating	6160	Cooling	1500
Avg. Temp. (°F)	Winter	39	Summer	67
Avg. Insol.(Ly/d)	Winter	273	Summer	482

SOLAR ENERGY SYSTEM

Application Heating 55% Cooling 0% Hot Water 75%

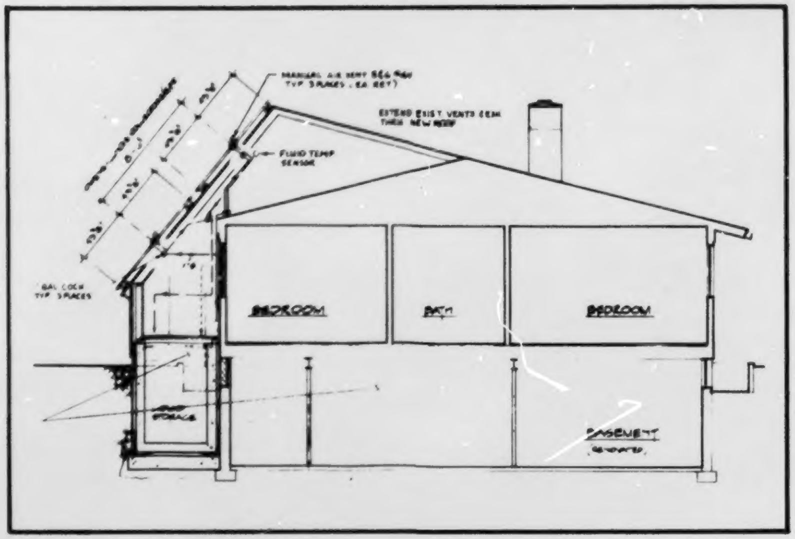
Collector
  Type: Air flat-plate
  Area (sq. ft.): 702
  Manufacturer: Solaron Corp.

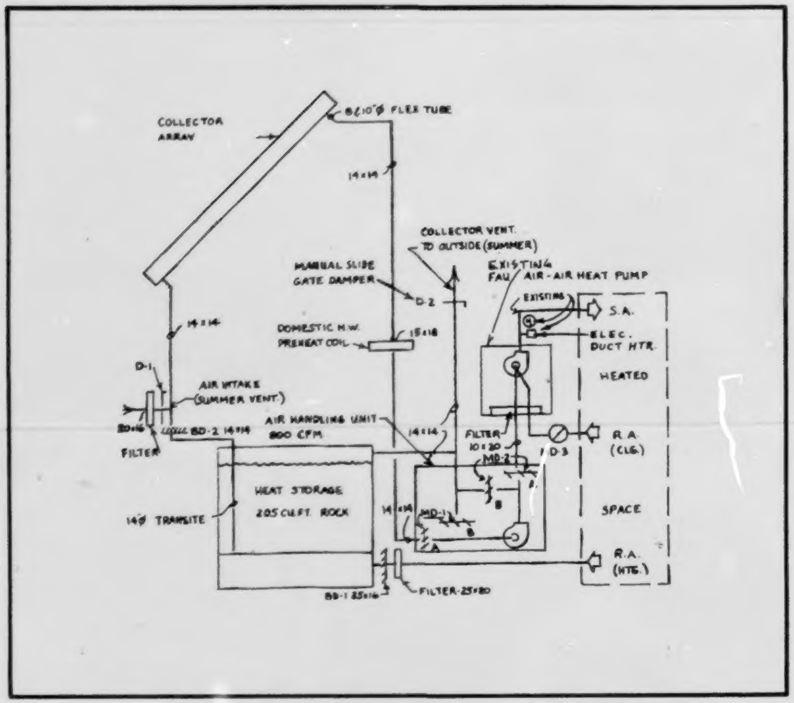
Storage
  Type: Rock
  Capacity: 400 sq.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air, and higher performance collectors in a cold climate.


MANUAL AIR VENT
TYP 3 PLACES (EA SET)
EXTEND EXIST VENTS (EA)
THRU NEW ROOF
FLUID TEMP
SENSOR
BAL COCK
TYP 3 PLACES
BEDROOM
BATH
BEDROOM
STORAGE
BASEMENT
(RENOVATED)


COLLECTOR
ARRAY
8/10"Ø FLEX TUBE
14×14
COLLECTOR VENT.
TO OUTSIDE (SUMMER)
MANUAL SLIDE
GATE DAMPER
D-2
EXISTING
FAU
AIR-AIR HEAT PUMP
EXISTING
S.A.
ELEC.
DUCT HTR.
DOMESTIC H.W.
PREHEAT COIL
15×18
14×14
D-1
AIR INTAKE
(SUMMER VENT)
20×16
BD-2 14×14
FILTER
AIR HANDLING UNIT
800 CFM
14×14
FILTER
10×20
MD-2
D-3
HEATED
R.A.
(CLG.)
HEAT STORAGE
205 CU.FT. ROCK
14Ø TRANSITE
14×14
MD-1
A
B
SPACE
R.A.
(HTG.)
BD-1 25×16
FILTER-25×20

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
- Type: Residential, single family
- Area: 1996 sq.ft.(total); 1597(conditioned)

Location: Offutt Air Force Base, Nebraska

Latitude: 41°N

Climatic Data

Degree Days	Heating	6160	Cooling	1500
Avg. Temp. (°F)	Winter	39	Summer	67
Avg. Insol.(Ly/d)	Winter	273	Summer	482

SOLAR ENERGY SYSTEM

Application Heating 55% Cooling 0% Hot Water 69%

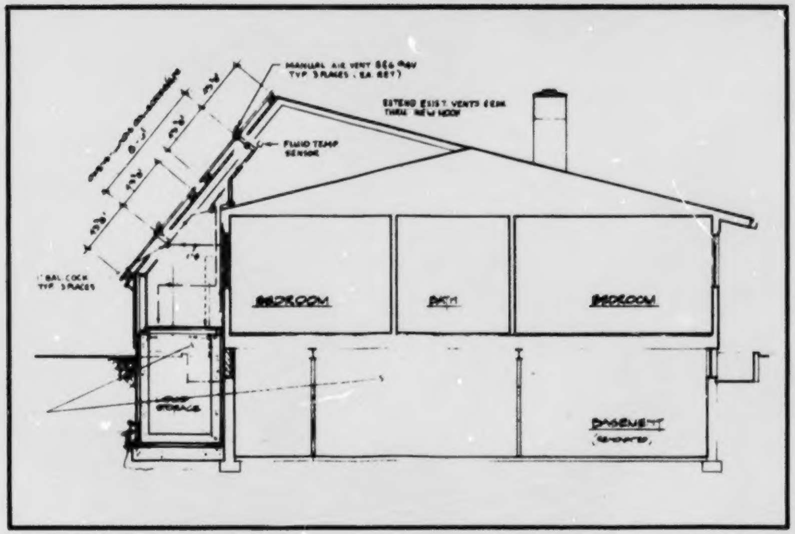
Collector
- Type: Evacuated tube
- Area (sq. ft.): 608
- Manufacturer: Owens Illinois Company

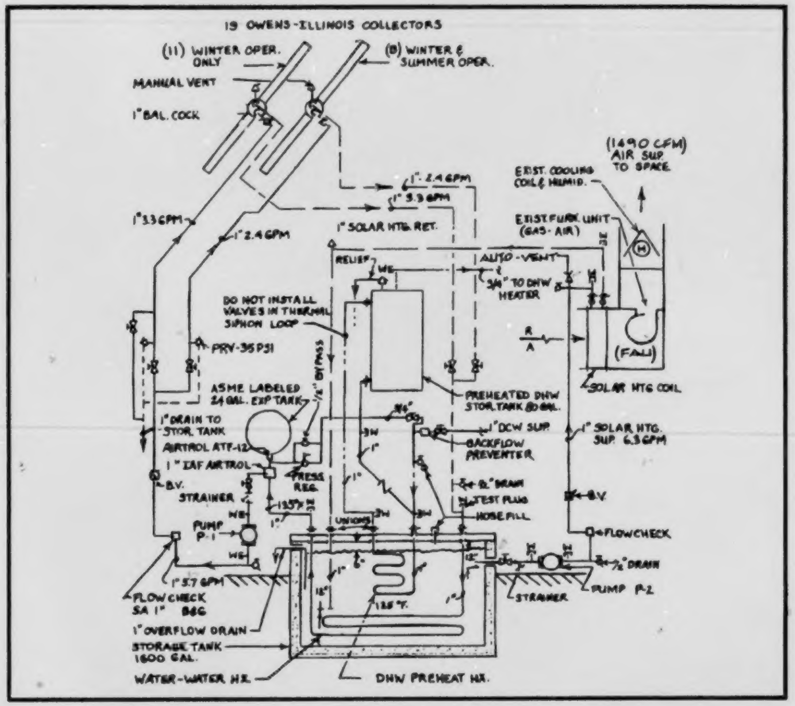
Storage
- Type: Water
- Capacity: 217 sq.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare systems: liquid, air, and higher performance collectors in a cold climate.


MANUAL AIR VENT B&G #4V TYP 3 PLACES (EA SET)
EXTEND EXIST. VENTS ECH. THRU NEW ROOF
FLUID TEMP SENSOR
1" BAL. COCK TYP 3 PLACES
BEDROOM
BATH
BEDROOM
STORAGE
BASEMENT


19 OWENS-ILLINOIS COLLECTORS
(11) WINTER OPER. ONLY
(8) WINTER & SUMMER OPER.
MANUAL VENT
1" BAL. COCK
1" 2.4 GPM
1" 3.3 GPM
1" 3.3 GPM
1" 2.4 GPM
1" SOLAR HTG. RET.
(1490 CFM) AIR SUP. TO SPACE
EXIST. COOLING COIL & HUMID.
EXIST. FURN. UNIT (GAS-AIR)
RELIEF
AUTO-VENT
3/4" TO DHW HEATER
DO NOT INSTALL VALVES IN THERMAL SIPHON LOOP
PRV-35 PSI
1/2" BYPASS
R
A
(FAN)
SOLAR HTG COIL
ASME LABELED 24 GAL. EXP TANK
PREHEATED DHW STOR. TANK 80 GAL.
1" DRAIN TO STOR. TANK
AIRTROL ATF-12
1" IAF AIRTROL
1" DCW SUP.
BACKFLOW PREVENTER
1" SOLAR HTG. SUP. 6.3 GPM
PRESS. REG.
1/2" DRAIN
TEST PLUG
HOSE FILL
B.V.
STRAINER
PUMP P-1
UNIONS
B.V.
FLOWCHECK
1/2" DRAIN
1" 5.7 GPM
FLOW CHECK SA 1" B&G
STRAINER
PUMP P-2
135°F.
1" OVERFLOW DRAIN
STORAGE TANK 1600 GAL.
WATER-WATER HX.
DHW PREHEAT HX.

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date:

Total Estimated ERDA Funds: To be determined

Building
- Type: Residential, single family
- Area: 1,392 sq.ft.

Location: Fort Bragg, North Carolina

Latitude: 35°N

Climatic Data

Degree Days	Heating	3365	Cooling	2100
Avg. Temp. (°F)	Winter	50	Summer	71
Avg. Insol.(Ly/d)	Winter	287	Summer	460

SOLAR ENERGY SYSTEM

Application Heating 79% Cooling 0% Hot Water 80%

Collector
- Type: Liquid flat-plate
- Area (sq. ft.): 504
- Manufacturer: Honeywell, Inc.

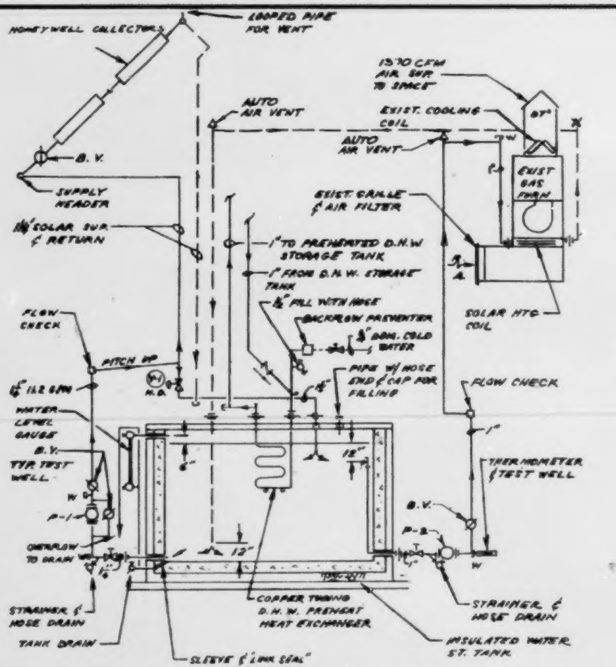
Storage
- Type: Water
- Capacity: 159.96 cu.ft./unit

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To demonstrate the use of east-west facing dwellings with solar heating.

307


HONEYWELL COLLECTORS
LOOPED PIPE FOR VENT
1370 CFM AIR SUP. TO SPACE
AUTO AIR VENT
EXIST. COOLING COIL
AUTO AIR VENT
B. V.
SUPPLY HEADER
EXIST. GRILLE & AIR FILTER
EXIST GAS FURN
1½" SOLAR SUP. & RETURN
1" TO PREHEATED D.H.W STORAGE TANK
1" FROM D.H.W. STORAGE TANK
½" FILL WITH HOSE
BACKFLOW PREVENTER
¾" DOM. COLD WATER
SOLAR HTG COIL
FLOW CHECK
PITCH UP
PIPE W/ HOSE END & CAP FOR FILLING
1½" 11.2 GPM
FLOW CHECK
WATER LEVEL GAUGE
B.V.
TYP. TEST WELL
6"
12"
1"
THERMOMETER & TEST WELL
W
P-1
B.V.
P-2
OVERFLOW TO DRAIN
12"
W
STRAINER & HOSE DRAIN
COPPER TUBING D.H.W. PREHEAT HEAT EXCHANGER
STRAINER & HOSE DRAIN
INSULATED WATER ST. TANK
TANK DRAIN
SLEEVE & "LINK SEAL" GASKET (TYPICAL)

SOLAR DRAIN DOWN SYSTEM

308

PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, single family
Area: 1,392 sq.ft.

Location: Fort Bragg, North Carolina

Latitude: 35°N

Climatic Data

Degree Days	Heating	3365	Cooling	2100
Avg. Temp. (°F)	Winter	50	Summer	71
Avg. Insol.(Ly/d)	Winter	287	Summer	470

SOLAR ENERGY SYSTEM

Application Heating 63% Cooling 0% Hot Water 75%

Collector

Type: Liquid flat-plate
Area (sq. ft.): 384
Manufacturer: Reynolds

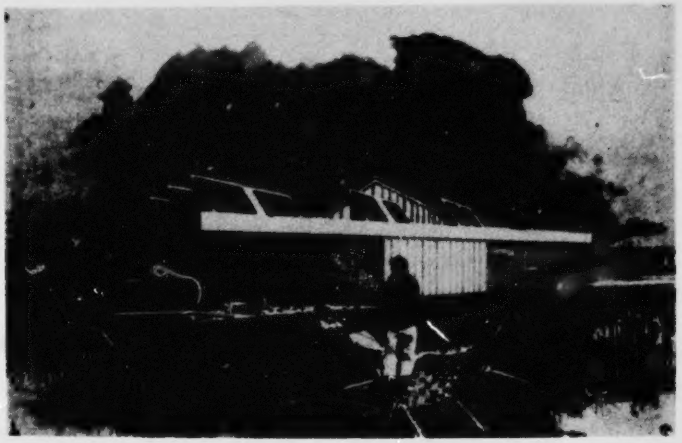
Storage

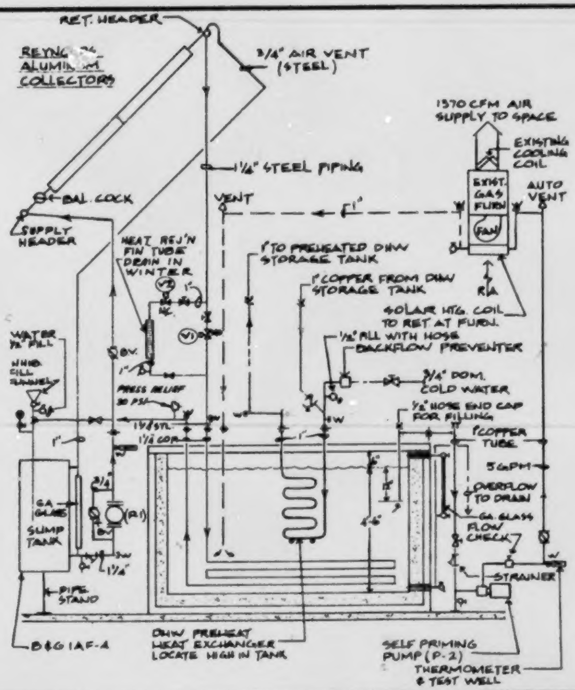
Type: Water
Capacity: 160 cu.ft./unit

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To demonstrate the use of east-west facing dwellings with solar heating.




RET. HEADER
REYNOLDS ALUMINUM COLLECTORS
3/4" AIR VENT (STEEL)
1370 CFM AIR SUPPLY TO SPACE
EXISTING COOLING COIL
1¼" STEEL PIPING
EXIST. GAS FURN.
FAN
AUTO VENT
BAL. COCK
VENT
1"
SUPPLY HEADER
HEAT REJ'N FIN TUBE DRAIN IN WINTER
1" TO PREHEATED DHW STORAGE TANK
1" COPPER FROM DHW STORAGE TANK
R/A
V2
V1
SOLAR HTG. COIL TO RET AT FURN.
WATER ½" FILL
½" FILL WITH HOSE BACKFLOW PREVENTER
HHID FILL FUNNEL
B.V.
3/4" DOM. COLD WATER
PRESS RELIEF 30 PSI
½" HOSE END CAP FOR FILLING
1½" STL.
1½" COP.
1" COPPER TUBE
5GPM
GA. GLASS
SUMP TANK
3/4
(P1)
1¼"
4'-6"
OVERFLOW TO DRAIN
GA. GLASS FLOW CHECK
STRAINER
PIPE STAND
B&G IAF-4
DHW PREHEAT HEAT EXCHANGER LOCATE HIGH IN TANK
SELF PRIMING PUMP (P-2)
THERMOMETER & TEST WELL

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

Area: 1532 sq.ft.

Location: Grand Forks AFB, North Dakota

Latitude: 48°N

Climatic Data

Degree Days	Heating 9940	Cooling 500
Avg. Temp. (°F)	Winter 32	Summer 55
Avg. Insol.(Ly/d)	Winter 244	Summer 484

SOLAR ENERGY SYSTEM

Application Heating 53% Cooling 0% Hot Water 70%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 450

Manufacturer: Honeywell/Lennox

Storage

Type: Water

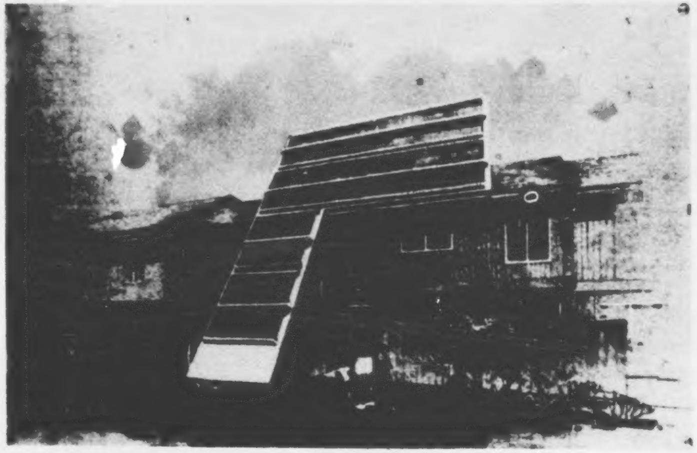
Capacity: 133 sq.ft.

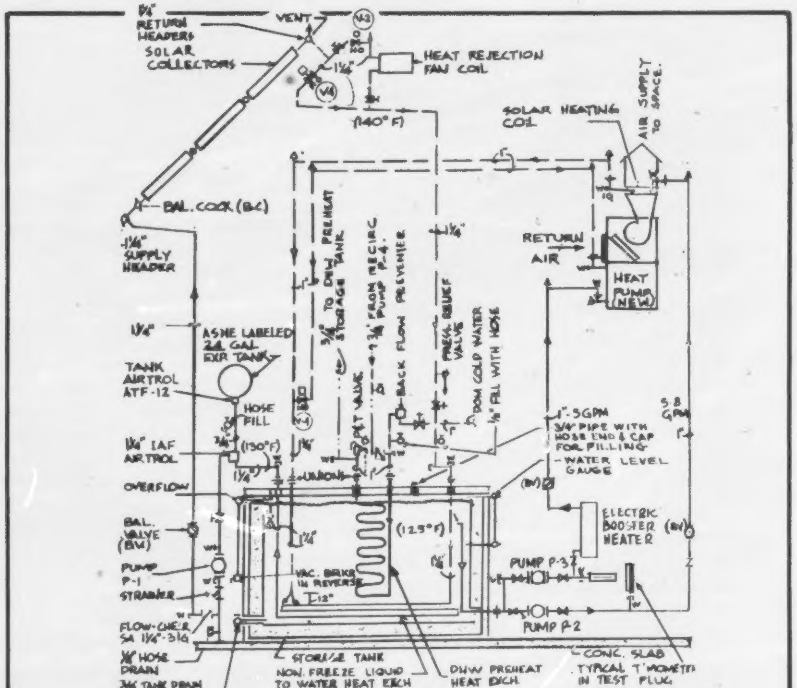
Auxiliary System Type: Water-to-air heat pump w/elec. booster

PROJECT DESCRIPTION

Objective(s): To compare alternative methods for solar equipping townhouses.

311




1¼" RETURN HEADERS
VENT
V2
SOLAR COLLECTORS
1¼"
V4
HEAT REJECTION FAN COIL
(140° F)
SOLAR HEATING COIL
AIR SUPPLY TO SPACE.
BAL. COCK (BC)
1¼" SUPPLY HEADER
¾" TO DHW PREHEAT STORAGE TANK
1¾" FROM RECIRC PUMP P-4.
BACK FLOW PREVENTER
1¼"
PRESS. RELIEF VALVE
DOM COLD WATER
½" FILL WITH HOSE
RETURN AIR
HEAT PUMP (NEW)
1¼"
ASME LABELED 24 GAL EXP TANK
TANK AIRTROL ATF-12
HOSE FILL
1¼" IAF AIRTROL
(130°F)
1¼"
UNIONS
OVERFLOW
BAL. VALVE (BV)
PUMP P-1
STRAINER
VAC. BRKR IN REVERSE
12"
FLOW-CHEK SA 1¼"-316
¾" HOSE DRAIN
¾" TANK DRAIN SLEEVE AND LINK SEAL GASKET
STORAGE TANK
NON. FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH.
(125°F)
1"-5GPM
¾" PIPE WITH HOSE END & CAP FOR FILLING
-WATER LEVEL GAUGE
(BV)
5.8 GPM
ELECTRIC BOOSTER HEATER
(BV)
PUMP P-3
PUMP P-2
CONC. SLAB
TYPICAL T'MOMETER IN TEST PLUG

NON-FREEZE LIQUID AND HEAT PUMP

312

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
Type: Residential, rowhouse
Area: 1523 sq.ft.

Location: Grand Forks AFB, North Dakota

Latitude: 48°N

Climatic Data

Degree Days	Heating 9940	Cooling 500
Avg. Temp. (°F)	Winter 32	Summer 55
Avg. Insol.(Ly/d)	Winter 244	Summer 484

SOLAR ENERGY SYSTEM

Application Heating 43% Cooling 0% Hot Water 70%

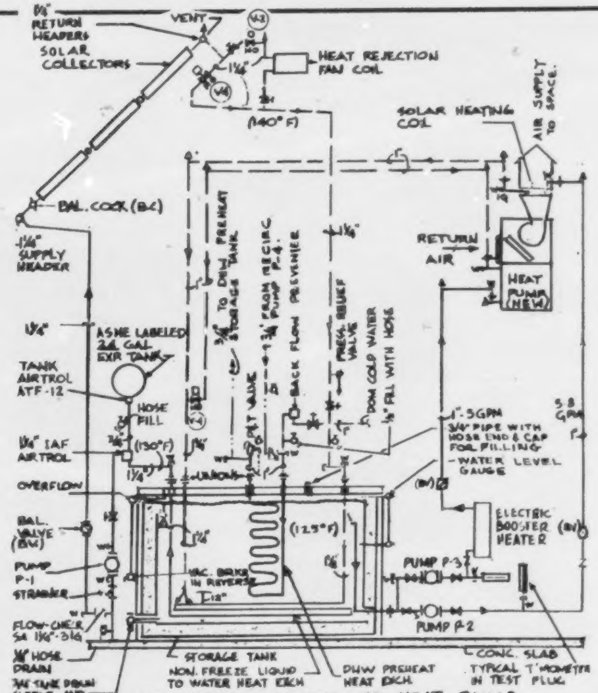
Collector
Type: Heat trap flat-plate
Area (sq. ft.): 450
Manufacturer: Daystar

Storage
Type: Water
Capacity: 133 sq.ft.

Auxiliary System Type: Water-to-air heat pump w/elec. booster

PROJECT DESCRIPTION

Objective(s): To compare alternative methods for solar equipping townhouses.


1¼" RETURN HEADERS
VENT
V3
SOLAR COLLECTORS
1¼"
HEAT REJECTION FAN COIL
V4
(140° F)
SOLAR HEATING COIL
AIR SUPPLY TO SPACE.
BAL. COCK (BC)
1¼" SUPPLY HEADER
1¼"
RETURN AIR
HEAT PUMP (NEW)
1¼"
ASME LABELED 24 GAL EXP TANK
¾" TO DHW PREHEAT STORAGE TANK
1¼" FROM RECIRC PUMP P-4
BACK FLOW PREVENTER
PRESS. RELIEF VALVE
DOM COLD WATER
½" FILL WITH HOSE
TANK AIRTROL ATF-12
HOSE FILL
PET VALVE
1"-5GPM
¾" PIPE WITH HOSE END & CAP FOR FILLING
-WATER LEVEL GAUGE
3.8 GPM
1¼" IAF AIRTROL
(130°F)
1¼"
UNIONS
OVERFLOW
(BV)
BAL. VALVE (BV)
ELECTRIC BOOSTER HEATER
(125°F)
PUMP P-1
STRAINER
VAC. BRKR IN REVERSE
12"
PUMP P-3
PUMP P-2
FLOW-CHEK SA 1¼"-31G
¾" HOSE DRAIN
STORAGE TANK
NON. FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH.
CONC. SLAB
TYPICAL T'MOMETER IN TEST PLUG
¾" TANK DRAIN SLEEVE AND LINK SEAL GASKET

NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential rowhouse

Area: 1532 sq.ft.

Location: Grand Forks AFB, North Dakota

Latitude: 48°N

Climatic Data

Degree Days	Heating	9940	Cooling	500
Avg. Temp. (°F)	Winter	32	Summer	55
Avg. Insol.(Ly/d)	Winter	244	Summer	484

SOLAR ENERGY SYSTEM

Application Heating 31% Cooling 0% Hot Water 70%

Collector

Type: Evacuated tube

Area (sq. ft.): 512

Manufacturer: Owens-Illinois Company

Storage

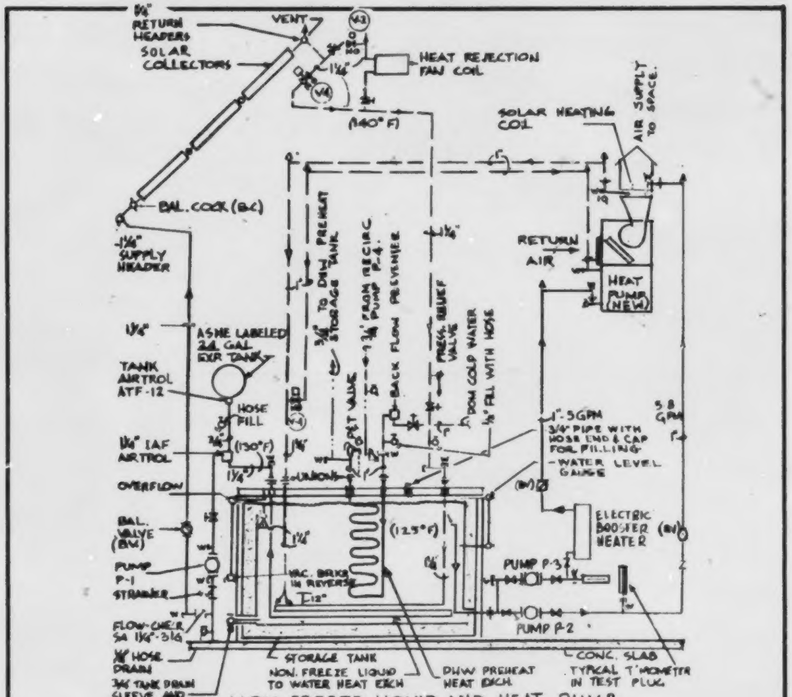
Type: Water

Capacity: 133 sq.ft.

Auxiliary System Type: Water-to-air heat pump w/elec. booster

PROJECT DESCRIPTION

Objective(s): To compare alternative methods for solar equipping townhouses.


1¼" RETURN HEADERS
VENT
V2
SOLAR COLLECTORS
1¼"
HEAT REJECTION FAN COIL
V4
(140° F)
SOLAR HEATING COIL
AIR SUPPLY TO SPACE.
BAL. COCK (B.C)
1¼" SUPPLY HEADER
¾" TO DHW PREHEAT STORAGE TANK
1¼" FROM RECIRC PUMP P-4.
BACK FLOW PREVENTER
PRESS. RELIEF VALVE
DOM COLD WATER
½" FILL WITH HOSE
1¼"
RETURN AIR
HEAT PUMP (NEW)
1¼"
ASME LABELED 24 GAL EXP TANK
TANK AIRTROL ATF-12
HOSE FILL
(130°F)
1¼" IAF AIRTROL
1¼"
UNIONS
OVERFLOW
1" - 5GPM
¾" PIPE WITH HOSE END & CAP FOR FILLING
- WATER LEVEL GAUGE
5.8 GPM
BAL. VALVE (BV)
(BV)
(125°F)
1¼"
ELECTRIC BOOSTER HEATER
PUMP P-1
STRAINER
VAC. BRKR IN REVERSE
12"
PUMP P-3
PUMP P-2
FLOW-CHECK SA 1¼"-316
¾" HOSE DRAIN
¾" TANK DRAIN SLEEVE AND LINK SEAL GASKET
STORAGE TANK
NON. FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH
CONC. SLAB
TYPICAL T'MOMETER IN TEST PLUG

NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building

Type: Residential, rowhouse

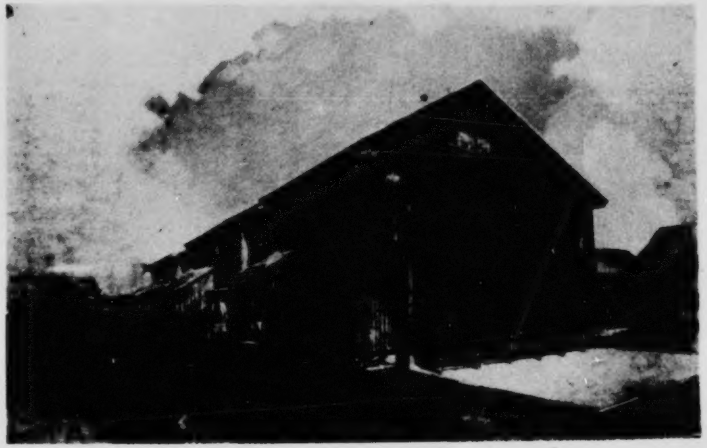
Area: 1523 sq.ft.

Location: Grand Forks AFB, North Dakota

Latitude: 48°N

Climatic Data

Degree Days	Heating	9940	Cooling	500
Avg. Temp. (°F)	Winter	32	Summer	55
Avg. Insol.(Ly/d)	Winter	244	Summer	484



SOLAR ENERGY SYSTEM

Application Heating 24% Cooling 0% Hot Water 65%

Collector

Type: Liquid flat-plate

Area (sq. ft.): 468

Manufacturer: AMETEK

Storage

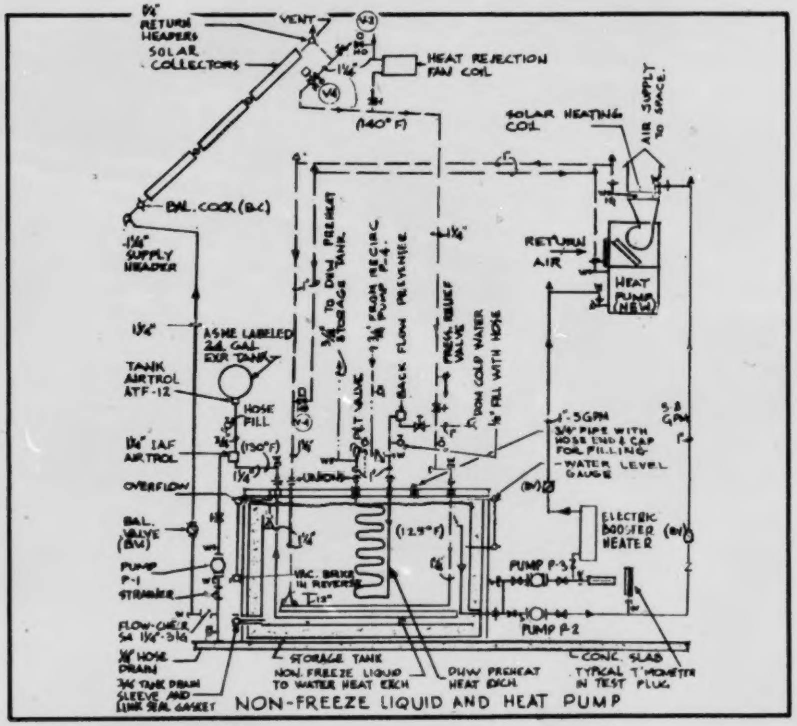
Type: Water

Capacity: 133 sq.ft.

Auxiliary System Type: Water-to-air heat pump w/elec. booster

PROJECT DESCRIPTION

Objective(s): To compare alternative methods for solar equipping townhouses.


1½" RETURN HEADERS
SOLAR COLLECTORS
VENT
V3
1¼"
V4
HEAT REJECTION FAN COIL
(140° F)
BAL. COCK (B.C)
1¼" SUPPLY HEADER
1¼"
ASME LABELED 24 GAL EXP. TANK
TANK AIRTROL ATF-12
HOSE FILL
1¼" IAF AIRTROL
(130°F)
1¼"
OVERFLOW
UNION
3/4" TO DHW PREHEAT STORAGE TANK
3/4" FROM RECIRC PUMP P-4
BACK FLOW PREVENTER
PRESS. RELIEF VALVE
DOM COLD WATER
½" FILL WITH HOSE
SOLAR HEATING COIL
AIR SUPPLY TO SPACE
RETURN AIR
HEAT PUMP (NEW)
1"-5GPM
3/4" PIPE WITH HOSE END & CAP FOR FILLING
-WATER LEVEL GAUGE
5.8 GPM
BAL. VALVE (BV)
PUMP P-1
STRAINER
FLOW-CHEK SA 1¼"-31G
3/4" HOSE DRAIN
3/4 TANK DRAIN SLEEVE AND LINK SEAL GASKET
VAC. BRKR IN REVERSE
(125°F)
ELECTRIC BOOSTER HEATER
PUMP P-3
PUMP P-2
STORAGE TANK
NON. FREEZE LIQUID TO WATER HEAT EXCH
DHW PREHEAT HEAT EXCH
CONC. SLAB
TYPICAL T'MOMETER IN TEST PLUG

NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Navy
Contractor:
Operational Date: April 1977
Total Estimated ERDA Funds: To be determined
Building
Type: Residential, apartment 2 units
Area: 1,083 sq.ft.
Location: Charleston Naval Base, South Carolina
Latitude: 33°N

Climatic Data

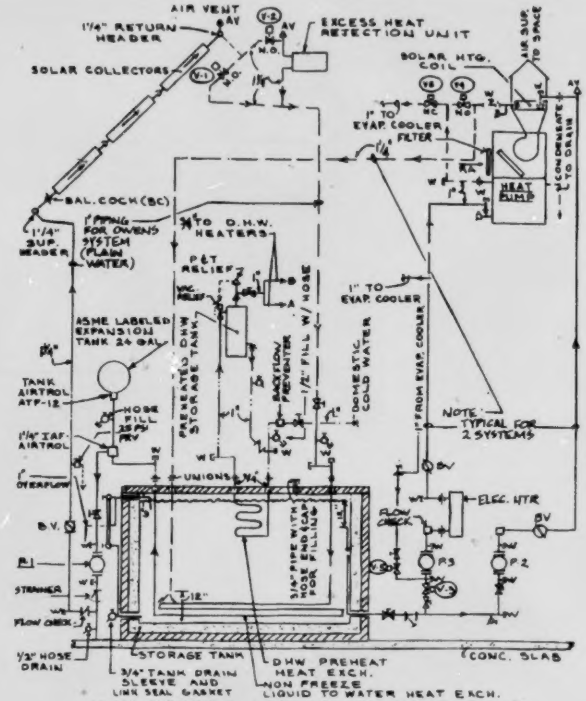
Degree Days	Heating	1973	Cooling	2800
Avg. Temp. (°F)	Winter	55	Summer	73
Avg. Insol.(Ly/d)	Winter	326	Summer	471

SOLAR ENERGY SYSTEM

Application Heating 66% Cooling 0% Hot Water 75%
Collector
Type: Liquid flat-plate
Area (sq. ft.): 324
Manufacturer: Honeywell, Inc
Storage
Type: Water
Capacity: 120 cu.ft.
Auxiliary System Type: Water-to-air heat pump

PROJECT DESCRIPTION

Objective(s): To compare systems: high performance liquid and air collectors in a hot-humid climate.


AIR VENT
AV
1¼" RETURN HEADER
V-2
AV
N.O.
EXCESS HEAT REJECTION UNIT
SOLAR COLLECTORS
V-1
N.O.
1¼"
SOLAR HTG. COIL
AIR SUP. TO SPACE
V8
V4
NC
NO
AV
1" TO EVAP. COOLER
FILTER
1¼"
RA
W
HEAT PUMP
CONDENSATE TO DRAIN
BAL. COCK (BC)
1" PIPING FOR OWENS SYSTEM (PLAIN WATER)
1¼" SUP. HEADER
¾" TO D.H.W. HEATERS
P&T RELIEF
VAC. RELIEF
A
1" TO EVAP. COOLER
ASME LABELED EXPANSION TANK 24 GAL
PREHEATED DHW STORAGE TANK
BACKFLOW PREVENTER
1/2" FILL W/ HOSE
DOMESTIC COLD WATER
1" FROM EVAP. COOLER
1¼"
TANK AIRTROL ATF-12
HOSE FILL
25 PSI PRV
1¼" IAF-AIRTROL
NOTE: TYPICAL FOR 2 SYSTEMS
1" OVERFLOW
UNIONS
¾"
BV
ELEC. HTR
FLOW CHECK
B.V.
BV
P1
P3
P2
V-5
V-3
STRAINER
FLOW CHECK
12"
3/4" PIPE WITH HOSE END & CAP FOR FILLING
1/2" HOSE DRAIN
STORAGE TANK
DHW PREHEAT HEAT EXCH.
CONC. SLAB
3/4" TANK DRAIN SLEEVE AND LINK SEAL GASKET
NON FREEZE LIQUID TO WATER HEAT EXCH.

NON-FREEZE LIQUID AND HEAT PUMP

PROJECT INFORMATION

Owner/Builder: Navy

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, apartment 2 units
  Area: 1353 sq.ft(total); 1083(conditioned)

Location: Charleston Naval Base, South Carolina

Latitude: 33°N

Climatic Data

Degree Days	Heating 1973	Cooling 2800
Avg. Temp. (°F)	Winter 55	Summer 73
Avg. Insol.(Ly/d)	Winter 326	Summer 471

SOLAR ENERGY SYSTEM

Application Heating 31% Cooling 0% Hot Water 15%

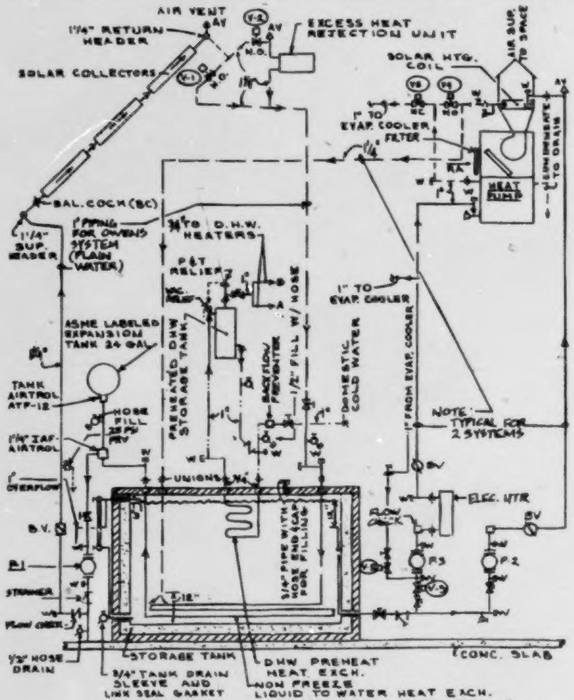
Collector
  Type: Evacuated tube
  Area (sq. ft.): 384
  Manufacturer: Owens Illinois Company

Storage
  Type: Water
  Capacity: 120 cu.ft.

Auxiliary System Type: Water-to-air heat pump

PROJECT DESCRIPTION

Objective(s): To compare systems: high performance liquid and air collectors in a hot-humid climate.


AIR VENT
AV
1¼" RETURN HEADER
SOLAR COLLECTORS
V-1
V-2
N.O.
EXCESS HEAT REJECTION UNIT
SOLAR HTG. COIL
AIR SUP. TO SPACE
1" TO EVAP. COOLER
FILTER
RA
HEAT PUMP
CONDENSATE TO DRAIN
BAL. COCK (BC)
1¼" SUP. HEADER
1" PIPING FOR OWENS SYSTEM (PLAIN WATER)
¾" TO D.H.W. HEATERS
P&T RELIEF
VAC. RELIEF
PREHEATED DHW STORAGE TANK
BACKFLOW PREVENTER
1/2" FILL W/ HOSE
DOMESTIC COLD WATER
1" TO EVAP. COOLER
1" FROM EVAP. COOLER
NOTE: TYPICAL FOR 2 SYSTEMS
ASME LABELED EXPANSION TANK 24 GAL
TANK AIRTROL ATF-12
HOSE FILL
1¼" IAF-AIRTROL
1" OVERFLOW
B.V.
P1
STRAINER
FLOW CHECK
UNIONS
3/4" PIPE WITH HOSE END & CAP FOR FILLING
12"
BV
ELEC. HTR
FLOW CHECK
P3
P2
V-3
1/2" HOSE DRAIN
STORAGE TANK
3/4" TANK DRAIN SLEEVE AND LINK SEAL GASKET
DHW PREHEAT HEAT EXCH.
NON FREEZE LIQUID TO WATER HEAT EXCH.
CONC. SLAB

NON-FREEZE LIQUID AND HEAT PUMP

321

322

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1534 sq.ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34°N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol.(Ly/d)	Winter	324	Summer	528

SOLAR ENERGY SYSTEM

Application Heating 69% Cooling 0% Hot Water 85%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 288
  Manufacturer: Honeywell, Inc.

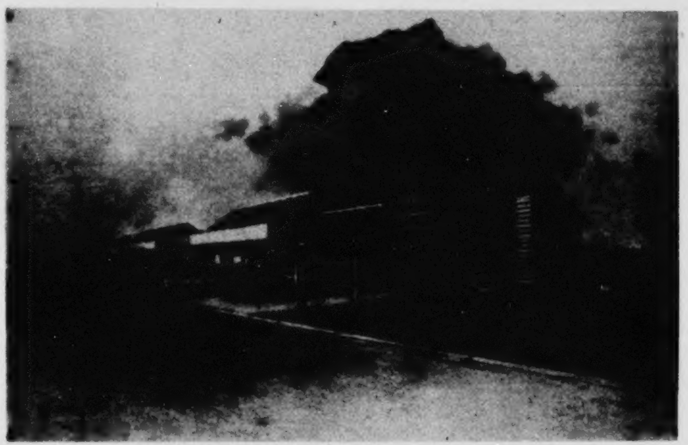
Storage
  Type: Water
  Capacity: 113 sq.ft.

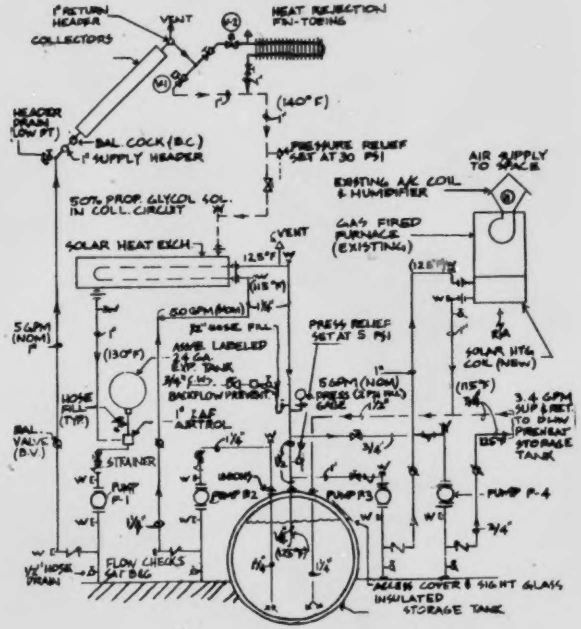
Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

323




1" RETURN HEADER
VENT
HEAT REJECTION FIN-TUBING
COLLECTORS
(140°F)
HEADER DRAIN (LOW PT)
BAL. COCK (B.C.)
1" SUPPLY HEADER
PRESSURE RELIEF SET AT 30 PSI
AIR SUPPLY TO SPACE
EXISTING A/C COIL & HUMIDIFIER
50% PROP. GLYCOL SOL. IN COLL. CIRCUIT
GAS FIRED FURNACE (EXISTING)
VENT
SOLAR HEAT EXCH.
125°F
(115°F)
(125°F)
5.0 GPM (NOM)
PRESS RELIEF SET AT 5 PSI
5 GPM (NOM)
(130°F)
ASME LABELED 24 GA. EXP. TANK
BACKFLOW PREVENT.
5 GPM (NOM)
PRESS GAGE
RA
SOLAR HTG. COIL (NEW)
(115°F)
3.4 GPM SUP & RET. TO DHW PREHEAT STORAGE TANK
HOSE FILL (TYP.)
1" 2AF AIRTROL
BAL. VALVE (B.V.)
STRAINER
PUMP P-1
PUMP P2
PUMP P3
PUMP P-4
3/4"
1/2" HOSE DRAIN
FLOW CHECKS
(125°F)
ACCESS COVER & SIGHT GLASS
INSULATED STORAGE TANK

324

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

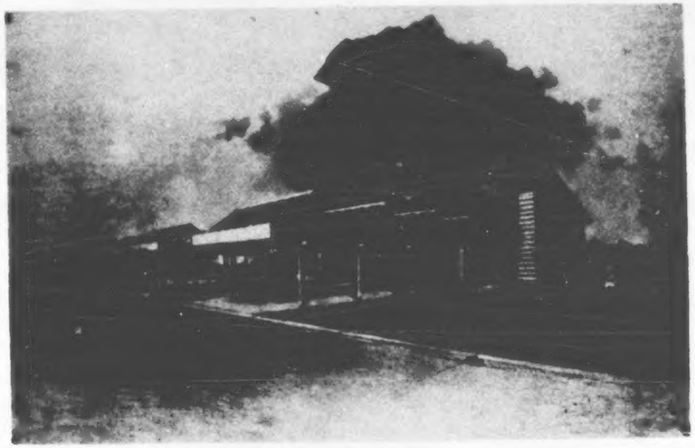
Building
  Type: Residential, rowhouse
  Area: 1534 sq.ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34°N

Climatic Data

Degree Days	Heating	3009	Cooling	2000
Avg. Temp. (°F)	Winter	48	Summer	76
Avg. Insol.(Ly/d)	Winter	324	Summer	528



SOLAR ENERGY SYSTEM

Application Heating 63% Cooling 0% Hot Water 80%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 336
  Manufacturer: Sunworks, Inc.

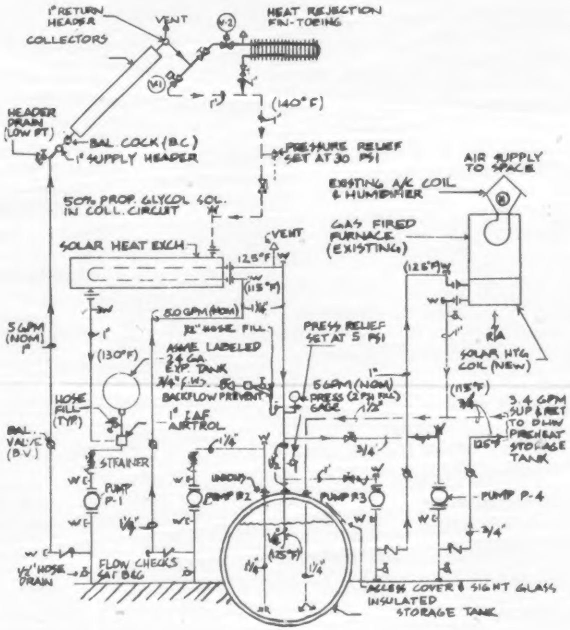
Storage
  Type: Water
  Capacity: 113 sq.ft.

Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

325


1" RETURN HEADER
VENT
V-2
HEAT REJECTION FIN-TOBING
COLLECTORS
V-1
1"
(140°F)
HEADER DRAIN (LOW PT)
BAL. COCK (B.C.)
1" SUPPLY HEADER
PRESSURE RELIEF SET AT 30 PSI
AIR SUPPLY TO SPACE
EXISTING A/C COIL & HUMIDIFIER
50% PROP. GLYCOL SOL. IN COLL. CIRCUIT
GAS FIRED FURNACE (EXISTING)
SOLAR HEAT EXCH
VENT
125°F
(115°F)
(125°F)
8.0 GPM (NOM)
1/2" HOSE FILL
PRESS RELIEF SET AT 5 PSI
5 GPM (NOM)
1"
(130°F)
ASME LABELED 24 GA. EXP. TANK
3/4" C.W.
BACKFLOW PREVENT
5 GPM (NOM)
PRESS (2 PSI FILL) GAGE
1/2"
R/A
SOLAR HTG COIL (NEW)
(115°F)
3.4 GPM SUP & RET TO DHW PREHEAT STORAGE TANK
125°F
HOSE FILL (TYP)
1" IAF AIRTROL
BAL. VALVE (B.V.)
1 1/4"
3/4"
STRAINER
UNIONS
PUMP P-1
PUMP P-2
PUMP P-3
PUMP P-4
1 1/4"
3/4"
(125°F)
1/2" HOSE DRAIN
FLOW CHECKS SAT B&G
ACCESS COVER & SIGHT GLASS
INSULATED STORAGE TANK

326

PROJECT INFORMATION

Owner/Builder: Air Force

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse
  Area: 1534 sq.ft.

Location: Sheppard Air Force Base, Texas

Latitude: 34°N

Climatic Data

Degree Days	Heating 3009	Cooling 2000
Avg. Temp. (°F)	Winter 48	Summer 76
Avg. Insol.(Ly/d)	Winter 324	Summer 528

SOLAR ENERGY SYSTEM

Application Heating 48% Cooling 0% Hot Water 75%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 227
  Manufacturer: General Electric Co.

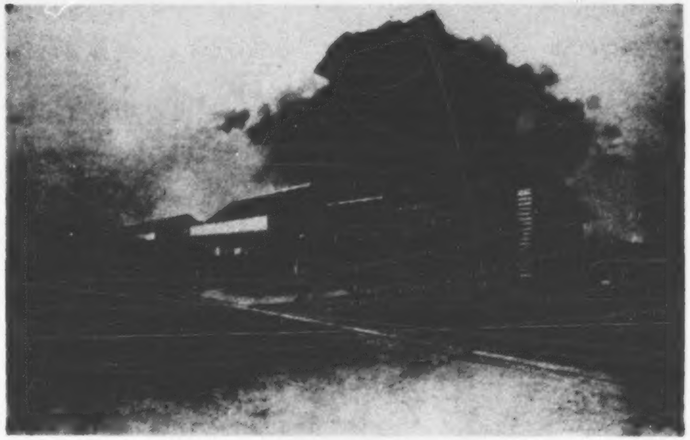
Storage
  Type: Water
  Capacity: 113 sq.ft.

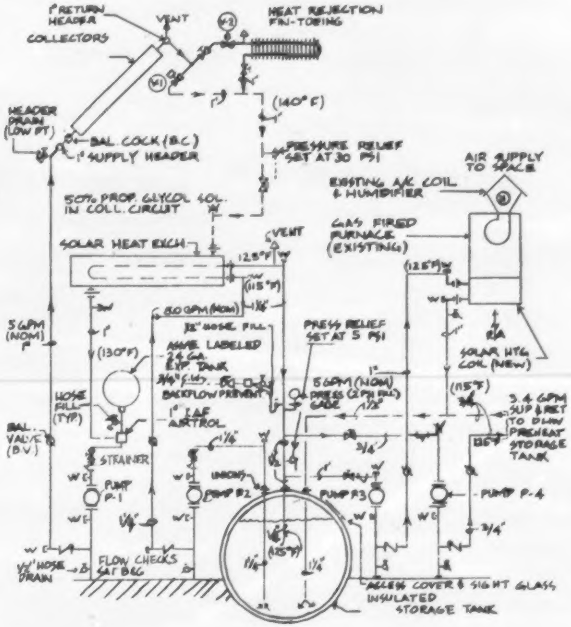
Auxiliary System Type: Gas furn. w/humidifier

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

327




1" RETURN HEADER
VENT
V2
HEAT REJECTION FIN-TUBING
COLLECTORS
V1
1"
(140°F)
HEADER DRAIN (LOW PT)
BAL. COCK (B.C.)
1" SUPPLY HEADER
PRESSURE RELIEF SET AT 30 PSI
AIR SUPPLY TO SPACE
EXISTING A/C COIL & HUMIDIFIER
50% PROP. GLYCOL SOL. IN COLL. CIRCUIT
GAS FIRED FURNACE (EXISTING)
SOLAR HEAT EXCH
VENT
125°F
(125°F)
(115°F)
1¼"
8.0 GPM (NOM)
½" HOSE FILL
PRESS RELIEF SET AT 5 PSI
5 GPM (NOM)
1"
(130°F)
ASME LABELED 24 GA. EXP. TANK
RA
SOLAR HTG COIL (NEW)
¾" C.W.
BACKFLOW PREVENT
5 GPM (NOM)
PRESS (2 PSI FILL) GAGE
1½"
(115°F)
3.4 GPM SUP & RET TO DHW PREHEAT STORAGE TANK
HOSE FILL (TYP.)
1" LAF AIRTROL
BAL. VALVE (B.V.)
1¼"
¾"
125°F
STRAINER
UNIONS
PUMP P-1
PUMP P2
PUMP P3
PUMP P-4
1¼"
¾"
(125°F)
½" HOSE DRAIN
FLOW CHECKS SAT BEG
1¼"
1¼"
ACCESS COVER & SIGHT GLASS
INSULATED STORAGE TANK

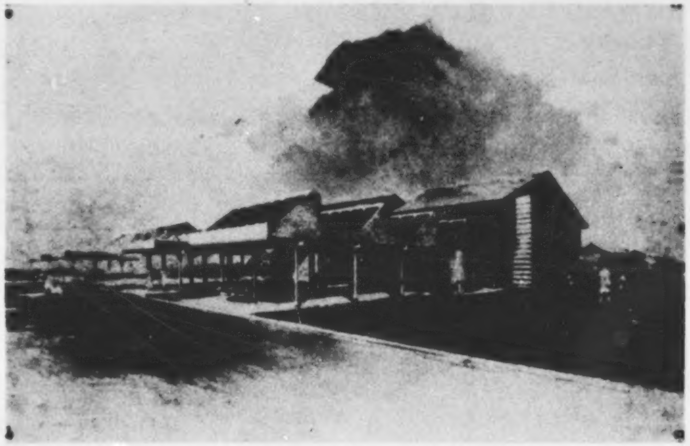
328

PROJECT INFORMATION

Owner/Builder: Air Force
Contractor:
Operational Date: April 1977
Total Estimated ERDA Funds: To be determined
Building
  Type: Residential, rowhouse
  Area: 1534 sq.ft.
Location: Sheppard Air Force Base, Texas
Latitude: 34°N

Climatic Data

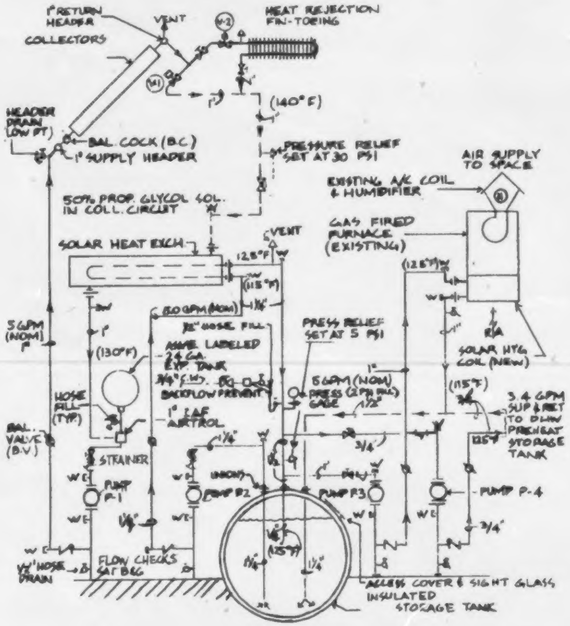
Degree Days	Heating 3009	Cooling 2000
Avg. Temp. (°F)	Winter 48	Summer 76
Avg. Insol.(Ly/d)	Winter 324	Summer 528



SOLAR ENERGY SYSTEM

Application Heating 59% Cooling 0% Hot Water 75%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 151
  Manufacturer: General Electric Co.
Storage
  Type: Water
  Capacity: 113 sq.ft.
Auxiliary System Type: Gas furn. w/humidifier


1" RETURN HEADER
VENT
V-2
HEAT REJECTION FIN-TUBING
COLLECTORS
V-1
(140°F)
HEADER DRAIN (LOW PT)
BAL. COCK (B.C.)
1" SUPPLY HEADER
PRESSURE RELIEF SET AT 30 PSI
AIR SUPPLY TO SPACE
EXISTING A/C COIL & HUMIDIFIER
50% PROP. GLYCOL SOL. IN COLL. CIRCUIT
GAS FIRED FURNACE (EXISTING)
SOLAR HEAT EXCH.
VENT
125°F
(115°F)
(125°F)
5.0 GPM (NOM)
1½"
1/2" HOSE FILL
PRESS RELIEF SET AT 5 PSI
5 GPM (NOM)
1"
(130°F)
ASME LABELED 24 GA. EXP. TANK
3/4" C.W.
BACKFLOW PREVENT.
SOLAR HTG COIL (NEW)
R/A
5 GPM (NOM)
PRESS (2 PSI FILL) GAGE
1/2"
(115°F)
3.4 GPM SUP & RET TO DHW PREHEAT STORAGE TANK
HOSE FILL (TYP.)
1" ZAF AIRTROL
BAL. VALVE (B.V.)
STRAINER
1¼"
3/4"
125°F
PUMP P-1
PUMP P2
PUMP P3
PUMP P-4
(125°F)
1½"
3/4"
1¼"
FLOW CHECKS SAT BEG
1/2" HOSE DRAIN
ACCESS COVER & SIGHT GLASS
INSULATED STORAGE TANK

PROJECT DESCRIPTION

Objective(s): To compare fixed and tiltable collectors and to demonstrate a carport installation.

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PROJECT INFORMATION

Owner/Builder: Army

Contractor:

Operational Date: April 1977

Total Estimated ERDA Funds: To be determined

Building
  Type: Residential, rowhouse, 2 units
  Area: 1296 sq.ft.

Location: Fort Belvoir, Virginia

Latitude: 38°N

Climatic Data

Degree Days	Heating	4333	Cooling	1143
Avg. Temp. (°F)	Winter	46	Summer	67
Avg. Insol.(Ly/d)	Winter	260	Summer	453

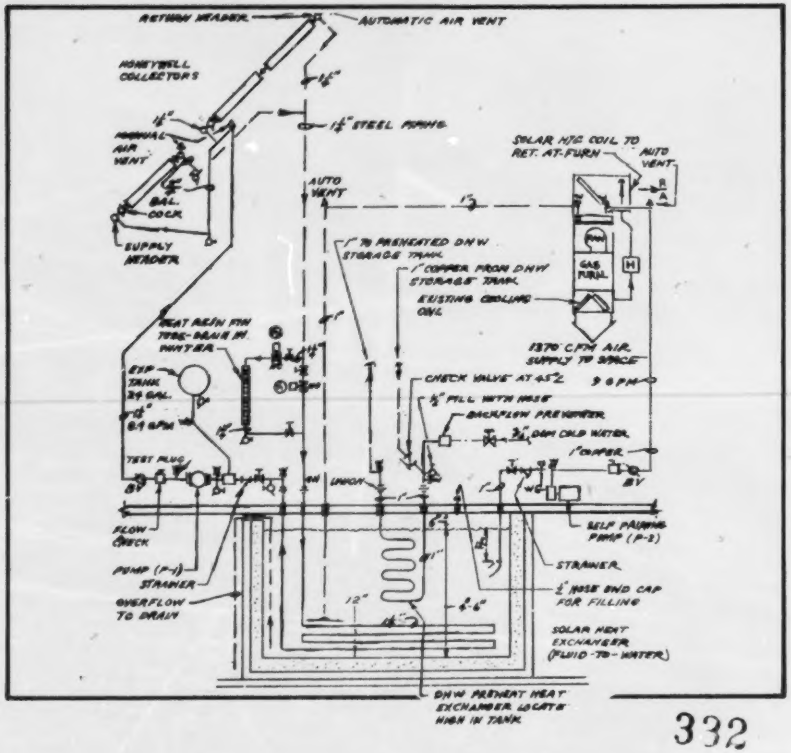
SOLAR ENERGY SYSTEM

Application Heating 80% Cooling 0% Hot Water 85%

Collector
  Type: Liquid flat-plate
  Area (sq. ft.): 378
  Manufacturer: Honeywell, Inc.

Storage
  Type: Liquid
  Capacity: 159.96 cu.ft./unit

Auxiliary System Type: Gas furn. w/humidifier


RETURN HEADER
AUTOMATIC AIR VENT
HONEYWELL COLLECTORS
1½"
1½" STEEL PIPING
MANUAL AIR VENT
BAL. COCK
SUPPLY HEADER
AUTO VENT
1½
SOLAR HTG COIL TO RET. AT FURN
AUTO VENT
R
A
1" TO PREHEATED DHW STORAGE TANK
1" COPPER FROM DHW STORAGE TANK
GAS FURN.
H
EXISTING COOLING COIL
1370 CFM AIR SUPPLY TO SPACE
HEAT RESIN FIN TUBE-DRAIN IN WINTER
EXP TANK 24 GAL.
1½"
8.1 GPM
CHECK VALVE AT 45°
9 GPM
½" FILL WITH HOSE
BACKFLOW PREVENTER
¾" DOM COLD WATER
1" COPPER
TEST PLUG
BV
UNION
1"
BV
SELF PRIMING PUMP (P-2)
FLOW CHECK
PUMP (P-1)
STRAINER
STRAINER
½" HOSE END CAP FOR FILLING
OVERFLOW TO DRAIN
12"
4'-6"
SOLAR HEAT EXCHANGER (FLUID-TO-WATER)
DHW PREHEAT HEAT EXCHANGER LOCATE HIGH IN TANK

PROJECT DESCRIPTION

Objective(s): To compare the impact of user variations on solar system performance.